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REVIEW OF RETENTION AND PERSISTENCE STUDIES FOR THE CALIFORNIA PUBLIC UTILITIES COMMISSION (CPUC)

FINAL REPORT

Submitted to:
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ORGANIZATION OF THE REPORT

1 EXECUTIVE SUMMARY

This detailed review of retention and realization studies analyzed the approach, data, methods, and conclusions associated with 54 reports representing 94 studies. The evaluation method and evaluation criteria are summarized in the report, but included:

- conformance with CPUC protocols,
- sampling approach, sample sizes and data collection procedures,
- modeling approach, estimation method, and consideration of alternative models, and
- results and implications.

Resource benefit, net (RBn) dollars were associated with studies where it was possible to assign the claims to specific programs and studies (they could be assigned for 50 of the 54 studies). The total dollars assigned were $2,217,908,000.[1]

The SERA team examined the lowest scoring reports to assess whether or not the EULs should be adjusted. We conducted a detailed examination of the 14 reports that were assigned a "C-" or less (26% of all the reports we evaluated). These studies represented 22.5% of the Resource Benefit, net dollars reviewed.[2] In addition, all reports that received a C+ or lower and had EUL realization rates of over 1.0 (i.e., accepted *ex post* EULs that were greater than the *ex ante* EULs) were examined.

This analysis yielded seven low scoring studies with proposed *ex post* EULs that were greater than *ex ante* values for the measures. One additional study highlighted an issue with methodology. The results are presented in Table 1.1. The analyses supporting the results are discussed in greater detail in the report and are summarized in Chapter 8.

Table 1.1 also presents information on the dollar values at risk (presented in 1997 dollars), based on our review of the studies and our computations based on resource benefit dollars, net.[3] Computations of claim dollars at risk were provided by the utilities in response to data requests from SERA. The computations estimate that more than approximately $399,000 in shareholder earnings claim dollars are affected by the findings, with the "net" being potentially higher claims to the utilities, attributable to *ex post* EULs that were longer for lighting measures in residential applications.

[1] Six percent of the studies were Third year studies, 47% were Fourth year studies, 25% were Sixth year studies, and 23% were Ninth year studies. Eighteen covered agricultural measures, 22 covered commercial, 25 covered industrial, and 35 covered residential measures (some studies covered more than one sector). Only about 10% of the RBn dollars were assigned to the residential sector; the vast majority was assigned to non-residential measures. Three studies covered Southern California Gas Company programs (6% of studies, 0.1% of RBn dollars), eight covered Southern California Edison (15%, 34% of RBn), 16 were associated with PG&E programs (30%, 23% of RBn), and 27 addressed SDG&E programs (50%, 43% of RBn dollars). Lighting measures were most frequently addressed, followed by HVAC, process measures, and motors, drives, and pumps.

[2] Specifically, 15.4% ($319,992,000 in 12 studies) received C-, 1.4% ($28,510,000 in 1 study) received D+, and 5.7% ($118,490,000 in 1 study) received D-.

[3] The SERA team understands that these values may have been rejected during the ORA review process; however these recommendations are based on the studies and the associated dollars we had available.

Table 1.1. Summary of EUL Estimate Recommendations for Low Scoring Retention Studies

Study	Resource Benefit, net – total for study	Recommendation	Shareholder Earnings Claim Dollar Impacts[4]
SDG&E Study 924&960: 1994 & 1995 Commercial Energy Efficiency Incentives. Fourth Year Retention Evaluation.	$184,820,000 (9% of total RBn reviewed)	Reject *ex post* estimates for T8 and occupancy sensors, accept *ex ante* values.	$0 SDG&E used *ex ante* figures in filing computations.
SDG&E Study 985: 1996 & 1997 Residential Appliance Efficiency Incentives Program: Compact Fluorescent Lights Sixth Year Retention Evaluation.	$31,292,000 (1.5% of total RBn reviewed)	Allow longer *ex post* values for CFLs (7.5 vs. 6.4 years); retain *ex ante* values for fixtures.	+$403,212[5] Approximate figure. One year extension in EUL; SDG&E used *ex ante* EULs in filing computations.
SDG&E Study 921: 1994 & 1995 Residential Appliance Efficiency Incentives: Compact Fluorescent Lights. Fourth Year Retention Evaluation.	$28,510,000 (1.4% of total RBn reviewed)	Allow longer *ex post* values for CFLs (10.2 years vs. 7.5 years); retain *ex ante* values for fixtures.	-$4,180[6]
SDG&E Study 922: 1994 & 1995 Residential Appliance Efficiency Incentives Program: Compact Fluorescent Lights: Sixth year Retention Study.	$30,506,000 (1.5% of total RBn reviewed)	Allow longer *ex post* values for CFLs (8.0 vs. 7.5 years); support adoption of *ex post* value reducing EUL value for fixtures (17.2 reduced from 20.0 years).	$0 Filing uses nearest year, so 7.5 was rounded to 8.
PG&E Study 315R2, 321R2, 329R2, 331R2: 6th Year Retention Study of Pacific Gas and Electric's 1994 and 1995 Energy Efficiency Incentives Programs, Agricultural Sector Measures.	$19,835,000 (1% of total RBn reviewed)	Accept longer *ex post* value for heat curtains (15.0 vs. 5.0 years); accept *ex ante* values for all measures analyzed.	$0
SCG Study 718: 1995 Commercial New Construction Program 4th Year Retention Study.	RBn dollars not available	Reject ex ante estimates for ovens and fryers (12 years) and adopt EUL of 6.9 years for ovens and 5.6 years for fryers. Also recommend modification of methodology for acceptance or rejection of ex ante values to allow measures to include provisions that have already met or surpassed the median failure rate.	$0 SCG made no 1997 AEAP claim for new construction program.
SDG&E Study 927&963: 1994 & 1995 Industrial Energy Efficiency Incentives 4th Year Retention Study	$21,261,000 (1% of total RBn reviewed)	Reject *ex post* values for exit signs and ballasts, accept *ex ante* values for other measures.	$0 SDG&E used *ex ante* figures in filing computations.
SDG&E Study 993 & 1017: 1996 & 1997 Commercial Energy Efficiency Incentives 4th Year Retention Study	$139,190,000 (6% of total RBn reviewed)	Reject ex post estimate for optical reflectors, accept ex ante value. Allow longer ex post values for CFLs Accept ex post value for 11-15 watt CFLs (8.8 years vs. 2 years).	$0 SDG&E used *ex ante* figures in filing computations.
Total	**$455,414,000**		**+$399,032**

[4] Claim dollar computations provided by utilities as response to data requests from SERA, October 2004.

[5] Sum of $434,986 for 1996 RAEI CFL bulbs, and +$371,439 from 1997 RAEI CFLs (total $806,425). This was multiplied by half because the EUL extension is 1.1 years. SDG&E computations used their traditional assumptions of rounding to the nearest full year. This had the effect of adding 2 years to the lifetime (from 6 to 8 years). We used half this figure to more closely approximate the extension recognized by this change in EUL.

[6] $0 for 1994 RAEI CFLs / fixtures; and -$4,180 for 1995 RAEI CFLs / fixtures.

2 INTRODUCTION AND BACKGROUND

The California Public Utilities Commission (CPUC) requested a detailed third-party review of retention and persistence studies, program milestones and accomplishments in support of shareholder earnings claims. The work was performed as part of the review of the IOU applications under the current consolidated AEAP proceeding, and included the following assignments:

- Pre-1999 (1998 or earlier) program years (PY) -- review of earnings computations / inputs based on savings estimates based on impact evaluations and retention / persistence work.
- PY 1999-2000 – review of earnings computations / inputs based on reaching or surpassing milestone goals.
- PY 2001-2002 – review of earnings computations / inputs based on a combination of energy savings estimates and impacts / retention work in combination with progress on milestone goals.

The work was conducted as an independent review to support regulatory proceedings, and this report addresses the review of retention or "measure life" studies. A separate, concurrent effort reviewed the milestones and program accomplishments.

Skumatz Economic Research Associates, Inc. (SERA) was the project lead for this assignment. The overall project team consisted of SERA, Summit Blue Consulting, LLC, Quantec, LLC, Global Energy Partners, EMCOR Energy and Technology, and Northwest Research Group. The work for this report on retention studies was conducted by:

- SERA and Quantec conducted the technical review of retention studies and computation of impacts, and SERA managed the project.
- EE&T and NWRG reviewed the quality of on-site and telephone data collection work.[7]

Retention studies (also called measure life or persistence studies) are statistical studies that test the assumptions about the length of time that program-installed energy efficiency measures remain in place. In computing the present value of benefits in DSM programs, utilities use *ex ante* assumptions about estimated useful lifetimes (EULs). Retention studies gather information from homes or businesses in which the measures were installed to determine if the measures are being removed earlier than expected – a difference that would affect the program's value. The California protocols require retention studies to test these assumptions under a set of guidelines, and the purpose of this project is to review the retention studies associated with pre-1999 program years.

This report summarizes the process and results from the review of the retention studies, including the collection of the retention studies and other relevant information, the development

[7] Summit Blue and GEP were focused on the milestones and accomplishments review portion of the project.

of the spreadsheet used in reviewing of the retention studies, and the re-evaluation of selected retention studies.

While retention studies were the focus, the project also evaluated 6 realization rate studies, which are discussed separately in this document.

2.1 Assembling Retention Studies and Protocol Information

Eighty retention studies were initially identified by the CPUC to be reviewed as part of this project. These studies corresponded to program years 1993 through 1997 for four utilities: Pacific Gas & Electric, San Diego Gas & Electric, Southern California Edison, and Southern California Gas. However, partway through the project, additional studies were added to the scope and the results of this final count of 94 retention studies (including several whole-building studies) and 6 realization rate studies are included in this report.

The Protocols and Procedures suggested that the data be combined from more than one program year to increase the sample size for the analysis, and therefore the reliability of the results. Because most of the retention studies combined two program years, the number of unique retention studies to be reviewed was 54.

The electronic documents were obtained online from the California Measurement Advisory Council (CALMAC) website: http://www.calmac.org/search.asp.CALMAC online database. While the majority of the studies were available electronically, many retention studies – approximately 30% – had to be obtained directly from the utilities.

Additional information regarding the protocols was obtained from the California DSM Measurement Advisory Council (CADMAC) website:http://www.calmac.org/cadmac-protocols.asp. This website provided all the protocols relevant to program evaluation. In particular, "Protocols And Procedures For The Verification Of Costs, Benefits, And Shareholder Earnings From Demand-Side Management Programs", was most helpful for the retention reviews.

The Protocols and Procedures outlined the requirements for reporting in the retention analysis. Table 6B Retention Studies of the Protocols and Procedures describes the summary table for the measure level data to be reported. This information is related to the expected useful life of the measure, the *ex ante* values of the measure and the *ex post* expected useful life used by the utility in the third and fourth earnings claims. Table 7B of the Protocols and Procedures outlines the documentation protocols for data quality and processing for retention studies. It provides an outline for overview information, database management, sampling, and data screening and analysis.

2.2 Inventory of Retention Reports

The retention studies estimate the expected useful life of the measures within a program and are designed to address the topics laid out in the protocols. All of the retention studies present information for Protocol-stipulated tables (table 6 and table 7) in the appendices of the reports. The body of the reports vary considerably depending on the utility and the author of the report. The number of studies reviewed by sector and utility is presented in the Tables 2.1, 2.2, and 2.3 below. The largest number of studies were for measures in the residential sector; however,

many of the studies for non-residential measures included combined sectors, and the majority of studies covered non-residential measures. The greatest numbers of studies were conducted for SDG&E programs, followed by PG&E.

Table 2.4 shows that 25 of the studies reviewed were "fourth year" retention studies, although 6th and 9th year studies combined represented another 25 studies. The most common measures studied were lighting, HVAC, process, and pumps, motors, and drives. These figures are summarized in Table 2.5.

The overall list of reports is included as Attachment A.

Table 2.1. Sectors Covered by Retention Studies Reviewed

Sector	Total studies reviewed
Agricultural	7
Commercial	8
Commercial/Industrial / Military	3
Commercial/Industrial/Agricultural	4
Industrial	7
Industrial/Agricultural	1
Non-Residential New Construction	3
Residential	20
Residential Commercial/Industrial	1
Total	54

Table 2.2. Sectors Covered by Retention Studies Reviewed – Study addresses sector[8]

Sector	Total studies reviewed
Agricultural	18
Commercial	22
Industrial	25
Residential	35

Table 2.3. Utilities Covered by Retention Studies Reviewed

Utility	Number of studies reviewed
Pacific Gas & Electric	16
Southern Cal Edison	8
San Diego Gas & Electric	27
Southern Cal Edison	3
Total	54

Table 2.4. Study Years Covered by Retention Studies Reviewed

Utility	Number of studies reviewed
Third year study	3
Fourth year study	25
Sixth year study	13
Ninth year study	12
N/A	1
Total	54

[8] Note that one study can cover multiple sectors.

Table 2.5. End Uses Covered by Retention Studies Reviewed

Utility	Number of studies reviewed
Lighting	43
HVAC	27
Shell	7
Motors / Drives	13
Pumps	16
Water	10
Cooking	6
Refrigeration	8
Air	6
Process	17
Miscellaneous	4

3 EVALUATION FRAMEWORK AND CRITERIA

This chapter addresses three evaluations or reviews that were performed. The largest and most comprehensive was the technical evaluation, which covered a wide range of procedure, data gathering, technical, and analytical issues associated with the retention studies. Two additional evaluations were also performed; these reviews analyzed the documentation and procedures for the on-site and telephone survey data collection work associated with the studies. The criteria and process for these reviews is included in this Chapter.

3.1 Development of the Technical Review Sheet

To provide an independent technical review of the retention studies, SERA and Quantec (the technical evaluation team) created an analytical review sheet designed to objectively assess key elements of each retention study.[9] It was designed to address all the requirements listed in Table 6 and Table 7 of the Protocols and Procedures, as well as other criteria used for evaluation of retention studies. Using a worksheet approach simplified comparison of studies, and allowed easy sorting on selected criteria. The Technical Review worksheet included major sections for background on the report, survey & sampling, data management & screening, retention modeling, staff & management of the report, and other comments.

In an effort to develop a review sheet that would reflect the DSM program verification procedures set forth by the CPUC, the evaluation team constructed an outline based on metrics identified in Tables 6 and 7 of the Protocol. Using the tables as a guideline, the original review sheet contained sections assessing broad topics such as database management, sampling, and data analysis. Within these broad categories, specific questions determined whether the retention study had met individual criteria as outlined by the Protocols.

SERA developed the initial criteria and review sheet, and Quantec suggested edits to the document. Because the retention study review was to be split between the two firms, clarity in criteria, common interpretations, and scoring methods were essential. Therefore, as a first step, staff from the two firms reviewed the same two retention studies. Using the review sheet outline as a guide, team members recorded their scores and explanations regarding both the adequacy of the study and effectiveness of the initial review sheet. After completing these independent reviews, the reviewers discussed their assessment of the retention studies, adherence to the Protocols, and review sheet's ability to accurately capture and describe the quality of the retention studies. A line-by-line review of the Technical Review Sheet was conducted jointly by all the technical review staff, discussing the interpretation of each metric, scoring method, what the retention studies should include in order to meet the specified criteria, and performance of each study on the criteria. Each column of the spreadsheet was discussed for each of the two studies, and some columns were added to provide additional or more detailed information.

It also became apparent during the course of the initial pilot review, that, while two retention studies may both fulfill a requirement of the Protocol, the effort put forth in doing so or the

[9] Protocols and Procedures for the Verification of Costs, Benefits, and Shareholder Earnings from Demand-Side Management Programs. California Public Utilities Commission Decision 99-03-XX, adopted by Decision 93-05-063, Revised March 1998.

explanation provided about how the requirement was met can differ significantly – reflecting the difference between meeting the "letter" and the "spirit" of the Protocol. The evaluation team believed it was critical that the review sheet be able to capture whether the study met only the letter (the minimum requirement as mandated by the Protocol) or also the spirit of the Protocol (i.e., the study goes beyond simply fulfilling the Protocol's mandates). In the example cases, meeting the spirit of the Protocol entailed providing sufficient explanation of issues related to the Protocol, collecting additional data or interpreting a model's results rather than simply listing them.

Considering these factors, the final review sheet provided the opportunity for the reviewer to score the retention study based on both whether it simply met the requirements of the Protocol and on the robustness of its compliance with the Protocol's essential elements. A set of four critical components were included, and scores were to be based on a five-point scale based on the elements making up each component – with 5 being the highest possible score and a 3 meaning the retention study merely met the criteria. Using the two sample studies, the evaluation team collectively decided what specifically constituted a 3, 4, or 5 for each criterion. For all these individual scores, a 3 indicates that the report meets the criteria minimally. A score of 5 is the highest a report can receive and indicates a thorough discussion and justification for the work that was done.

All staff assigned to conduct reviews of the retention studies participated in these scoring and criteria discussions, and helped finalize the Technical Review Sheet. Table 3.1 lists the four selected criteria and describes basis for the numeric scoring. The full Technical Review spreadsheet is included as Attachment B (an Excel spreadsheet under separate cover).

Part B of Table 7 of the Protocols requests the following information to be included and reported as part of retention studies. The information is to be prepared for each program, but where differences exist between specific measures, information noting those differences is also required. The Protocols specifically request information on all items, and request the information to be "brief but complete". This table served as the basis for developing our evaluation criteria for the analysis included in this report.

TABLE 7 DOCUMENTATION PROTOCOLS FOR DATA QUALITY AND PROCESSING[10]
B. RETENTION STUDIES

1. OVERVIEW INFORMATION

a. Study Title and Study ID No.: the study title and identification number should be identical to the information contained in the Statewide Bibliography. Changes in this information should be noted.
b. Program, program year (or years) and program description: The program and program year(s) should be identical to the information contained in the Statewide Bibliography.
c. End Uses and Measures covered: Use the end use designations agreed to in the Protocols.
d. Methods and models used: Describe the final model specification used fo the study. Where applicable, indicate the study location of the competing class or types of models that were estimated but were not selected. State why the final specification was chosen.
e. Analysis sample size: Provide the number of customers, number of installations, number of measures (if different) and the number of observation in the analysis and time periods of data collection. If different for different units of analysis, a summary table should be provided.

2. DATABASE MANAGEMENT

a. Identify the specific data sources for each data element
b. Diagram and describe the data attrition process commencing with the program database for participants. Specific numbers and decision points for inclusion and exclusion should be provided. Where different data sources are used

[10] "Protocols and Procedures for the Verification of Costs, Benefits, and Shareholder Earnings from Demand-Side Management Programs", As adopted by CPUC Decision 93-05-063, revised March 1998.

(e.g., surveys and program records), appropriate attrition categories should be used (e.g., response rates for surveys).

c. Describe the internal/organizational data quality checks and data quality procedures used to match customers and surveys, participation records, and any other data quality procedures used in the analysis.
d. Provide a summary of the data collected specifically for the analysis but not used, the reasons for them not being used, and a documentation of where those data reside.

3. SAMPLING

a. Sampling procedures and protocols: Describe the sampling procedures and protocols used. Information provided should include the sampling frame (e.g. eligible population), sampling strategy (e.g., random, stratified, etc.), sampling basis (e.g. customers, installation, rebate issued), and stratification criteria (e.g. geographic, etc.). Specific data and formulas should be used to present sampling goals and achieved results.
b. Survey information: Survey instruments should be provided. Response rates should be presented. Reasons for refusals should be presented in tabular form. Efforts to account for or test for non-response bias should be presented, as well as corrections to account for the bias.
c. Statistical descriptions: For the key variables that were used in the final models, provide descriptive statistics for the participant group, and, when present, for the comparison group.

4. DATA SCREENING AND ANALYSIS

a. Describe procedures used for the treatment of outliers, and missing data points.
b. Describe what was done to control for the effects of background variables, such as economic, political activity, etc.
c. Describe procedures used to screen data for inclusion into the final analysis dataset. Show how many customers, installations, or observations were eliminated with each screen. The reviewer should be able to clearly follow the development of the final analysis dataset.
d. Model statistics: For all final models, provide standard model statistics in a tabular form.
e. Specification: Refer to the section(s) of the Study that present the initial and final model specifications that were used, the rationale for each, and the documentation for the major alternative models used. In addition, the presentation of the specification should address, at a minimum, the following issues:
    - describe how the model specification and estimation procedures recognize and address heterogeneity of customers (i.e. cross-sectional variation)
    - discuss the factors, and their associated measures, that are omitted from the analysis, and any tests, reasoning, or special circumstances that justify their omission; and
f. Error in measuring variables: Describe whether and how this issue was addressed, and what was done to minimize the problem (e.g. response bias, measurement errors, etc.)
g. Influential data points: Describe the influential data diagnostics that were used, and how the identified outliers were treated.
h. Missing data: Describe the methods used for handling missing data during the analysis phase of the study.
i. Precision: Present the methods for the calculation of standard errors.

Table 3.1. Scoring Criterion

Criterion	Description
CPUC Protocol	Did they meet the CPUC protocol of using the top 10 measures or measures that account for 50% of the program savings? A score of 3 means that they just met the criteria, but the discussion of the measures selected and the program savings may have been weak; 5 was the highest score possible.
Sampling Strategy	Describe the sampling strategy whether it was stratified, random, etc. Describe the sampling and stratification basis and process. (i.e., customers, rebates, installations, etc.) Is there adequate discussion of the sampling process? Discuss problems with the strategy / basis if appropriate. A score of 3 indicated that the sampling strategy and basis was sufficient.
Fieldwork and Validation	What type of fieldwork was used to collect the data? How well is the data collection process explained? Describe the field work and validation of the data. This score reflected the adequacy of the field work done in collecting data and the thoroughness with which the data was validated.
Methodology	Is the description of the methodology adequate? Discuss the methodology implemented in the study. Were alternative models estimated or considered? Was the final selection of models well justified? Was data attrition sufficiently explained? Does the study adequately discuss the results of its model?

Both an overall score – the unweighted sum of the four individual scores (with a maximum of 20 points) and a letter grade (ranging from A-F) were assigned by the reviewer. The letter grade reflected an assessment of the study, with an emphasis (or higher weight) assigned to the quality of the methodology and data work in the study. This two-pronged approach to evaluating the studies ensured objectivity, and provided assessment of individual elements of the study and its overall performance.

3.1.1 Evaluation Criteria

The revised Technical Review Sheet was provided to the CPUC for review, the studies were assigned to staff, and the review work proceeded. Since part of evaluating the competence of a study was to measure it against similar studies, the evaluation team split the pool of CPUC-identified retention studies by sector, allowing better comparisons between and across studies. Tables 3.2-3.7 outline the six sections of the final review sheet, as well as a providing a brief description of each field.

The background on the report section included information about who wrote the report, what utility, sector, and program it covered, what measures were included, and if there was an Office of Ratepayers Advocates (ORA) report. The survey/sampling section was extensive. It included criteria regarding the protocol requirements on the number of measures to be included in the analysis, strength of the population, sampling strategy, type of survey, size and quality of sample, savings attributable to the sample, and some detailed information at the measure level, such as sample size, population size and number of failures. The data/management section followed the Protocols and Procedures closely. This section of the worksheet addresses attrition, data checks, and handling of outliers. The retention/modeling part of the worksheet is designed to evaluate the analytic methods used to estimate the EULs, whether alternative models were explored, whether the use of the model selected was well justified. The ex ante and ex post EULs for the measures as well as the realization rates are presented in this section. Staff/management describes the experience of the authors of the report. Other notes & comments provide an overall evaluation of the report, weak and strong points, and suggested improvements.

The detailed criteria and entries for each of these sections of the Technical Review sheet are presented in Tables 3.2-3.7. Note that the entries include both numeric and text entries. Text entries were incorporated to provide back-up, justification, and notes to support the scores provided in the spreadsheet.

Table 3.2. Background on Reports

Category	Description
Report Number	Assigned Id number
Reviewer	Last name of reviewer
Date Reviewed	Date
Author / Company	Name of Company, Location
Title	Title on Study
Report date	Date on Report
Utility Covered	Utility Covered
Program	Name of Program
Sector(s) covered	Sector(s) covered

Category	Description
Measure(s) covered / Study Measures	Measures covered by the program / measures included in the study. [Description]
Dates covered / AEAP Year	Dates for measures / Year AEAP was filed
ORA Report	Report type if available, who did it, what were their recommendations.
Synopsis / Purpose	Description of what the study covers

Table 3.3. Survey/Sampling

Category	Description
CPUC Protocol	Description of how they discuss the protocols: Is the criteria of the Top 10 measures or 50% of savings discussed? Is the criteria met?
Score for CPUC Protocol	1-5 with 5 being highest. Start with 3 if just meets the criteria.
Strategy / Basis	Describe the sampling strategy whether it was stratified, random, etc. Describe the sampling basis. (I.e., customers, rebates, installations, etc.) Discuss problems with the strategy / basis if appropriate.
Score for Strategy / Basis	1-5 with 5 being highest.
Strong population list?/ source	Describe the source for the population list. Discuss the strength of the source.
Survey? (type - onsite, phone, etc.)	Was a survey conducted? If so, what type, how many, etc.
Onsite Survey	YES [1], NO [0]
Phone Survey	YES [1], NO [0]
High quality field work, validation of fieldwork and data entry?	Describe the field work and validation of the data
Score for Quality of Fieldwork and Validation	1-5 with 5 being highest.
Inspection / verification techniques	Discuss how the status of the measures were verified.
Respondents (participants, nonpart, etc.)	Are these the correct respondents? What are the response rates?
Sample size -- is it sufficient?	What is the sample size? Report for each measure if available. Is it sufficient?
Stratification method & appropriateness	Discuss the stratification criteria used and its appropriateness.
Well-defined sampling / replacements methodology?	Discuss the replacement and re-contact strategy used. Is it thorough? Appropriate number / spacing of re-contacts before replacement
Bias Identification / Corrections taken	Discuss attempts to identify any potential bias. Were corrections needed, what corrections were taken? Was clustering an issue?
Installation Population	Describe the total installations in the program. Provide for each measure if possible.
Installation Sample	Describe the number of installations included in the sample/analysis.
Percent Installations	What is the percent of the total installations included in the sample. Specify for each measure if available.
Savings Population	What are the total savings generated by the program? Do they discuss it? [dollars or kWh]
Savings Sample	What are the savings generated by the sample/analysis?
Percent savings	What is the percent of the total savings generated by the sample/analysis?
Confidence Precision	What is the confidence and precision of the results? What method is used for the calculation of the standard errors?

Category	Description
Like Measures	Did the report identify measures that were not studied but have similar characteristics to measures that are included in the survey?
Appropriate phrasing of removal / operations questions regarding measures	Did the survey phrase the questions appropriately? How were removals and failures handled?
Other survey topics	Discuss any other survey topics.
Copy of instrument included?	Was the survey included? [y/n]
Number of Measures	Total number of measures included in the study. [number]
Number of Installations	
Number in Sample	Total number in Sample for all measures covered in the study [number]
Number of Failures	Total failures in sample for all measures [number]
Electronic data available?	Are the data available? What information is provided ?

Table 3.4. Data Management/Screening

Category	Description
Sources for data	Describe the data sources used in the analysis. Include the method of collection
Attrition	Describe the data attrition process beginning with the program database. Numbers and decision points should be included. Include all sources of data (program tracking, surveys, etc.)
Checks	Describe the internal data quality checks and data quality procedures used to match customers and surveys, participation records, and other data used in the analysis.
Unused Data	Provide a summary of the data collected specifically for the analysis but not used, the reasons for them not being used.
Outliers	Describe the treatment of outliers and missing data points.
Exogenous Factors	Describe what was done to control for the effects of background variables.
Data filters	Describe the procedures used to screen data for inclusion into the final analysis dataset. Show how many observations were eliminated with each screen.

Table 3.5. Retention Modeling

Category	Description
Adequate description of methodology?	Is the description of the methodology adequate? Discuss the methodology implemented in the study.
Analytic Methods / Model Utilized	Describe the final model specification used for the study.
Rationale for selection	State why to final specification was selected
Alternative models	Were any competing models considered? Describe them.
Score for methodology and modeling	1-5; 5 being highest
Weighting	Did they weight the data? Discuss how they did so.
Measure lifetime / EUL results, confidence intervals, not just point estimates?	Do they estimate the EUL and the 80% confidence intervals. What are they?
Appropriate / defensible conclusions?	What were their conclusions? Defensible?
Difference between adopted ex-post and ex-ante	Specify a number if they adopt the ex-ante, then 0.

Table 3.6. Staff Management

Category	Description
Staff / experience	What company and author (if available) did the study?
Management / Quality Control	Did field staff produce facility layout to show location of measures or place stickers on measure to call if removed and failed?

Table 3.7. Other Notes & Comments

Category	Description
Other notes and comments	Comment on the study, discuss any concerns or issues not already addressed.
Evaluation of Study -- weak / strong points	Evaluate the Study - Discuss strong and weak points in the study
Sum of all Scores	Sum of all scores [number]
Evaluation score // A-F	Grade (A being highest)
Needs Work? Suggestions?	What can / should be done / re-done to improve this study?
Original Order	
Dollars [thousands] claimed on Appendix E Program Year DSM tables	Dollars [thousands] claimed on Appendix E Program Year DSM tables

3.1.2 Review -- and Re-Review -- of Technical Studies

Once the final review sheet was approved, the evaluation team began reviewing their respective retention studies. Throughout the review process, members of the evaluation team met periodically to discuss the studies that had been reviewed to that time. The meetings provided forums for discussing concerns and/or issues that had arisen and helped ensure that each member of the team was scoring comparable issues similarly.

Of the 54 retention studies reviewed, 14 studies received letter grade of C- or lower. In an effort to validate the concerns of the initial reviewer, different members of the evaluation team reassessed the 14 studies to confirm the assessment reflected in the individual and overall scores. This process also allowed for indicators of whether recalibration between scores awarded by different reviewers was warranted. The secondary reviewers agreed on the assessments for all lower scoring studies. The results of the review are included in Section 5.1 of this report.

4 Assessment of On-site and Telephone Data Collection Work

The previous sections described the process for reviewing the technical, methodological, sample size, and other aspects of the work – and the conformance with protocols. Separate reviews of the quality of the on-site and phone data collection work were also conducted and are included in this chapter.

4.1 Assessment Methodology and Review Criteria for On-Site Data Collection

This section addresses the assessment of the on-site data collection work. Many of the retention studies in the scope of this project included some component of on-site data collection in the course of the evaluation. These specific studies, as listed in Table 4.3, were evaluated and scored according to the criteria described below in Table 4.2.

Naturally, the scope of this review is limited to the documentation provided in the associated report deliverables for the retention studies. In some cases, the results of this review may be a more relevant indicator of the quality of the documentation rather than of the on-site work itself; however, it was determined that it was incumbent on the report authors to thoroughly document their work.

4.1.1 Assessment Methodology and Review Criteria for On-Site Data Collection

Each of the 39 retention studies that used on-site data collection was evaluated based on criteria addressing three primary areas:

- Selection of sites for on-site work and explanation of sampling criteria
- Data collection tools and methodology
- Data preparation and validation

In each of these areas, various individual criteria were outlined, as shown on the Retention Study On-Site Data Collection Evaluation Criteria and Weighting Factors summary in Table 3.9. These criteria include a checklist of items that document the work associated with on-site data collection, in support of a technically sound overall retention study.

The individual criteria were established based on the engineering experience and best judgment of EMCOR Energy & Technologies (EE&T), the team member assigned to perform the detailed review of the on-site data collection work. A total of 18 criteria were used, representing industry best practices for procedures and documentation. Some of the individual criteria are considered “objective” items (e.g., checking if examples of data collection instruments were shown) while some are more “subjective” in nature (e.g., evaluating the quality and completeness of these instruments).

Each retention study was scored against the individual criteria and each of the individual criteria was ranked on a scale of 0 to 5, as outlined below in Table 4.1.

Table 4.1. Scoring Criteria for On-Site Data Collection Review

Potential Score	Basis
0	No documentation of procedures / results provided
1-4	Some documentation provided; vague and/or confusing description of procedures/results. Range of score up to discretion of reviewer based on information provided, and confirmed by second engineer's quality control check.
5	Procedures / results are well documented and easily understandable.

A detailed explanation of the scoring basis for each of the evaluation criteria is outlined in notes on the Evaluation Matrix spreadsheet. Note that a score of "5" was achieved for each of the criteria for at least one of the reports; this validates the reasonableness of the expectation that an "ideal" study could meet all of the criteria and achieve a perfect score. In fact, one of the 39 studies received a score of 100.

After each criterion was scored, an overall score for each retention study was calculated by applying a weighting factor for the criteria, resulting in an overall score based on a 100 point scale. These factors were determined based on an assessment of the criterion's relative importance. For example, the criterion "Examples of Survey Instruments and Forms", which has been given a weighting factor of 5, was deemed more important than the criterion "Documentation of Period of Field Data Collection," which has been given a weighting factor of 3. The sum of the weights of the criteria equals 100. The weighting factors given to each of the evaluation criterion are presented in Table 4.2 below.

Table 4.2. Retention Study Evaluation Criteria and Weighting Factors

Evaluation Area	Evaluation Criteria ID	Evaluation Criteria	Weighting Factor
Selection of Sites for On-site work and Explanation of Sampling Criteria	A	Documented Explanation of Sample Construction	15
	B	Documented Justification of Sample Selection	3
	C	Documented Justification of Sample Size	3
	D	Explanation Sample Population Screening/ Site Rejection	7
Data Collection Tools and Methodology	E	Documentation of Who Performed Data Collection	3
	F	Documentation of Data Collection Procedures	15
	G	Examples of Survey Instruments and Forms	5
	H	Quality of Survey Instruments and Forms, and Data Collected	5
	I	Documentation of Period of Field Data Collection	3
Data Preparation and Validation	J	Documentation of Data Transfer Process	3
	K	Quality of Data Transfer Process	3
	L	Documentation of Data Compilation Process	3
	M	Quality of Data Compilation Process	3
	N	Documentation of Data Culling/ Formatting/ Quality Control Processes	3
	O	Quality of Data Culling/ Formatting/ Quality Control Processes	3
	P	Documentation of Data Analysis Process	8
	Q	Quality of Data Analysis Process	5
	R	Presentation of Results	10
Sum of Weighting Factors			100

Based on the methodology outlined above, the score given to each retention study was calculated as follows:

*Retention Study Score = [Criteria A Weight] /100 * [Study Criteria A Score] /5 +*
*[Criteria B Weight] /100 * [Study Criteria B Score] /5 +*
. . .
*+ [Criteria R Weight] /100 * [Study Criteria R Score] /5*

In this manner, each study was given a score ranging from 0% to a "perfect" score of 100%.

4.1.2 Assessment Process

The first step in each retention study assessment was for the reviewer to assign credit for criteria that were included and could be readily found in the reports. For example, if a report were to mention the use of a survey tool, but did not describe or give an example of the tool, it would receive a score of zero for the associated category. This method of scoring was necessary due to the fact that, during the assessment, the reviewers did not have access to any other sources of information beyond the report documents. In fact, these studies are themselves the documentation provided to the CPUC for the related claims, so this assumption was deemed reasonable.

During the evaluation procedure the reviewer assigned a score for each evaluation criterion based on information found in the individual reports. The comment fields of the evaluation matrix spreadsheet were used to record references to locations (pages, sections, and/or table numbers) where relevant information could be found in the reports. Justifications for any assigned score less than 5 were also recorded in the comment sections.

After the evaluation of each study was completed, a second reviewer double-checked the findings and scoring to ensure the consistency and thoroughness of the reviews. The initials of the second reviewer are shown in the "QC" field of the Evaluation Matrix.

4.1.3 On-Site Data Collection Assessment Results

The following table (Table 4.3) summarizes the final scoring results for each study. Detailed scoring for each evaluation criteria can be found in Attachment B, which includes all notes and references.

As anticipated, the results of this assessment show that the quality and documentation of the on-site data collection work varies greatly. The overall scores range from 44% to 100%, with an average score of 80%. The low scoring reports typically reflected insufficient documentation across many different criteria, while the highest scoring studies validated the reasonableness of the criteria for a "perfect" score.

Table 4.3. Summary of Evaluation of On-Site Data Collection for Retention Studies

Report Number	Utility Covered	Evaluation Score
315R2, 321R2, 329R2, 331R2	PG&E	76%
354R1, 385R1, 335abcR1	PG&E	77%
354R2, 385R2, 335AR2, 335BR2, 335CR2	PG&E	76%
398R1 a,b,c,d,e,f,g	PG&E	44%
396R1 a,b,c,d,e,f	PG&E	56%
399R2	PG&E	54%
349R1, 351R1	PG&E	76%
310R2, 324R2, 312R2, 326R2	PG&E	71%
323R2, 424R1	PG&E	89%
322R2	PG&E	95%
311R2,382R2, 314R2, 325R2	PG&E	81%
353R1, 334abR1, 350R1	PG&E	83%
353R2, 334aR2, 350R1, 334bR1	PG&E	83%
372R1	PG&E	86%
529	SCE	100%
553	SCE	98%
555	SCE	81%
547 B&C, 558 B&C	SCE	98%
547	SCE	96%
529D	SCE	80%
548, 559	SCE	89%
937, 973	SDG&E	80%
925, 961	SDG&E	80%
936 & 972	SDG&E	77%
1005	SDG&E	75%
1026	SDG&E	75%
1000, 1024	SDG&E	75%
924 & 960	SDG&E	77%
927, 963	SDG&E	77%
928, 964	SDG&E	77%
930, 966	SDG&E	75%
931 and 967	SDG&E	75%
993 & 1017	SDG&E	75%
996, 1020	SDG&E	75%
997, 1021	SDG&E	75%
999 and 1023	SDG&E	75%
720	SCG	88%
716A	SCG	96%
718	SCG	91%
Maximum Score: 100%		
Average Score: 80%		
Minimum Score: 44%		

4.2 Assessment of Telephone Data Collection Work Quality

Northwest Research Group, Inc., a subcontractor for the team, completed an assessment in support of this project's overall evaluation of retention studies. The scope of the review includes the 26 retention studies that used telephone data collection.[11] The methodology and results of this review are summarized in this section of the report. A summary of the review process and results is also documented in spreadsheet form in the "Evaluation Matrix" included as Attachment C.

4.2.1 Scope of Telephone Data Collection Evaluation

Many of the retention studies in the scope of this project included some component of telephone survey data collection in the course of the evaluation. These specific studies, as listed in Table 4.4, were evaluated and scored according to pre-established criteria as outlined in the following section.

It is important to note that the scope of this review is limited to the documentation provided in the associated report deliverables for the retention studies. The results of this review are, in many cases, a more relevant indicator of the quality of the documentation rather than of the telephone survey work itself. NWRG anticipates that many of the organizations for which the reports were written may in fact have additional documentation provided by their survey research consultants in the form of separate reports or appendices. These additional documents provide more complete documentation of many of the common missing elements related to evaluating the data collection and validation process.

4.2.2 Assessment Methodology

4.2.2.1 Review Criteria

Each retention study was evaluated based on established criteria that address six primary areas:

- Problem Definition;
- Sample Design;
- Data Collection Tools;
- Data Collection Process and Validation;
- Data Analysis; and
- Reporting.

In each of these areas, various individual criteria were outlined, as shown on the Retention Study Evaluation Criteria and Weighting Factors summary in Table 4.4. These criteria include a checklist of items that represent a thorough set of processes and documentation for work associated with telephone survey data collection, in support of a technically sound overall retention study.

The individual criteria were established based on the Council of American Survey Research Organization's (CASRO) Guidelines for Survey Research Quality [12] and the survey research experience and best judgment of Northwest Research Group, Inc. (NWRG). A total of 14 criteria were used, representing industry best practices for procedures and documentation. Some of the individual criteria are considered "objective" items (e.g., checking if examples of data collection instruments were shown) while some are more "subjective" in nature (e.g., evaluating the quality and completeness of these instruments).

[11] 28 studies are included in the table, but 2 did not ultimately use telephone techniques.
[12] http://www.casro.org/guidelines.cfm

4.2.2.2 Scoring of Individual Criterion

Each retention study was scored against the individual criteria and each of the individual criterion was ranked on a scale of 0 to 5, as outlined below.

Table 4.4: Retention Study Evaluation Individual Criteria Scoring

Potential Score	Basis
0	No documentation of procedures/results provided
1-4	Some documentation provided; vague and/or confusing description of procedures/results.
5	Procedures/results are well documented and easily understandable.

4.2.2.3 Criteria Weighting Factors

The overall score for each retention study was calculated as the product of the assessment score and the associated weighting factor, resulting in an overall score based on a 100 point scale. These factors were determined based on NWRG's assessment of the associated criterion's relative importance. The sum of the weights of each criteria equals 100. The weighting factors given to each of the evaluation criteria are presented in Table 4.5 below.

Table 4.5: Retention Study Evaluation Criteria and Weighting Factors

Evaluation Area	Evaluation Criteria ID	Evaluation Criteria	Weighting Factor
Problem Definition	A	Research Objectives Clearly Stated	5
Sample Design	B	Universe or Population to Be Sampled Clearly Defined	10
	C	Criteria by which a Given Sample Element is Selected to be in the Sample Clearly Identified	8
Survey Instrument	D	Survey Instrument Included	5
	E	Quality of Survey Instrument	15
Data Collection / Validation	F	Documentation of the Firm Which Conducted the Interviewing	3
	G	Documentation of Data Collection Procedures	8
	H	Documentation of Dates Interviewing Conducted	3
	I	Documentation of Interview Length Included	3
	J	Documentation of Survey Validation and %	5
	K	Documentation of Final Disposition of Sample Elements / Completion Rate	10
Data Analysis	L	Documentation of Data Analysis Process	5
	M	Quality of Data Analysis	10
Reporting	N	Presentation of Results	10
Sum of Weighting Factors			100

4.2.2.4 Calculation of Overall Scores

Based on the methodology outlined above, the score given to each retention study is calculated as follows:

*Retention Study Score = [Criteria A Weight] /100 * [Study Criteria A Score] /5*
+
*[Criteria B Weight] /100 * [Study Criteria B Score] /5*
+
. . .
*[Criteria N Weight] /100 * [Study Criteria N Score] /5*

In this manner, each study was given a score ranging from 0% to a "perfect" score of 100%.

4.2.3 Assessment Process

The first step in each retention study assessment was for the NWRG reviewer to read the associated report. Given the scoring process described above, each retention study received credit for criteria that were included and could be readily found in the reports. For example, if a report were to mention the use of a survey tool, but did not describe or give an example of the tool, it would receive a score of zero for the associated category. This method of scoring was necessary due to the fact that during the assessment, the reviewers did not have access to any other sources of information beyond the report documents.

During the evaluation procedure, the NWRG reviewer assigned a score for each evaluation criteria based on information found in the individual reports. The comment and notes fields of the evaluation matrix spreadsheet were used to record justifications for any assigned score less than 5.

After the evaluation of each study was completed, a second reviewer double-checked the findings and scoring to ensure the consistency and thoroughness of the reviews. The initials of the second reviewer are shown in the "QC" field of the Evaluation Matrix.

4.2.4 Phone Survey Data Collection Assessment Results

The following table summarizes the final scoring results for each study. Detailed scoring for each evaluation criteria can be found in Attachment One, which includes all notes and references.

As anticipated, the results of this assessment show that the quality and documentation of the telephone survey data collection work varies greatly. The overall scores range from 40% to 97%, with an average score of 72%. The low scoring reports typically reflected insufficient documentation across many different criteria, while the highest scoring studies validated the reasonableness of the criteria for a "perfect" score.

Table 4.6. Summary of Evaluation of Telephone Data Collection from Retention Studies

Summary Statistics	
97%	High Score
72%	Average Score
40%	Low Score

Table 4.7. Telephone Score by Report

Report ID Number	Utility Covered	On-site Overall Report Score
931 and 937[13]	SDG&E	57%
529	SCE	85%
553	SCE	86%
555	SCE	68%
349R1, 351R1	PG&E	53%
315R2, 321R2, 329R2, 331R2	PG&E	40%
354R1, 385R1, 335abcR1	PG&E	40%
915	SDG&E	76%
921	SDG&E	76%
922	SDG&E	76%
933	SDG&E	76%
981	SDG&E	76%
984	SDG&E	76%
985	SDG&E	76%
990	SDG&E	80%
1002	SDG&E	76%
550/554[14]	SCE	89%
373 1R1	PG&E	71%
384R2, 401bR2[15]	*PG&E*	*N/A*
386R1	PG&E	92%
322R2	PG&E	92%
310R2, 324R2, 312R2, 326R2	PG&E	67%[16]
384aR2	PG&E	79%
384cR2	PG&E	79%
916	SDG&E	74%
934, 970	SDG&E	74%
958	SDG&E	74%
548, 559	SCE	97%
547	SCE	N/A (study was on-site)

[13] Study was initially scheduled to be conducted via on-site, changed to telephone methodology for convenience of respondent. Only one sample element eligible for survey. The report included on the CD and evaluated is labeled 931 & 967

[14] Note – Report ID included on CD and evaluated is 530/554

[15] This is not, per the report, a telephone survey – report indicates all data collected on-site

[16] Note: This study contained no documentation as to which surveys were conducted on-site vs. phone vs. both.

5 PRIORITIZATION AND DOLLAR ASSIGNMENTS

The studies were reviewed and sorted based on their scores and grades – and, as mentioned in the previous chapter, all studies that received grades lower than C were re-reviewed by other staff to confirm their ratings. This section discusses the process for assigning priorities for more detailed review, and for assigning proxies for dollars at risk represented by the studies.

5.1 Prioritization

Certainly, whether the studies were deficient was a key criterion in selecting those studies that would be reviewed in more detail, or represent candidates for remedy. However, to narrow and prioritize the potential pool, other criteria were also considered:

- Dollars at Risk / Level of shareholder funding involved / affected,
- Relevance for future stream / installments,
- Whether previous payments had been made, and the potential of rescinding funds,
- Timing / age of the study and installment number,
- Complexity / cost of repairing,
- Sector priorities,
- Random sampling, or
- Other criteria.

Ultimately, dollars at risk were the core criteria, but the other criteria were also considered to some degree in identifying studies to review in more detail. The results of the prioritization are discussed in Chapter 6 of this report.

The critical component in the prioritization was assigning dollars at risk. The process for this allocation and proxy computation is discussed in the remainder of this chapter.

5.2 Cost Allocation

In an effort to prioritize the importance of retention studies, a dollar value was assigned to the retention study. This dollar value is based on the net Resource Benefit, which is reported in the E-tables[17]. The net Resource Benefit presented in the E-tables references the retention study for each program year that the retention study covers.

5.2.1 Background

Under the DSM Measurement Protocols adopted by the California Public Utilities Commission in 1993 (and revised in 1998), the four major California investor-owned utilities are eligible to recover shareholder earnings based on the costs and benefits of major Demand-Side

[17] These are the completed forms from Appendix E – Reporting Requirement Protocols for AEAP Claims.

Management (DSM) program activities. The protocols identify two types of shareholder incentives authorized for two types of programs: Shared Savings and Performance Adder. The results of retention studies are related to Shared Savings earnings. Shared savings earnings are recovered in four earnings claims. The third and fourth earnings claims (filed in the 5th and 10th years after the programs) are based on the lifecycle savings estimate developed in retention and performance studies. The third and fourth claims amount to the revised estimate of the utility's share of the savings minus the amount already paid in prior claims.[18] Earnings claims are made one year after the program year, and earnings are authorized for payment in the AEAP filing two years after the program year. For example, for program year 1994, the first claim is filed in 1995, the second in 1996, and the third in 1999, and the fourth and final claim is filed in 2004.

According to the DSM Measurement Protocols, the results of the retention studies are used to revise lifecycle savings in the third and fourth earnings claims.[19] Retention studies are used to determine the effective useful life (EUL) of an end use or group of measures that comprise an end-use category. The EUL from a retention study is then used in the calculation of the Resource Benefit, net (RBn) of an end-use category within a program and relevant sectors. Although the RBn is used to calculate an earnings claim, it is only one component of the earnings claim. [20] The RBn for a program is revised each claim year based on the required persistence studies for that claim year as detailed in the DSM Measurement Protocols. The RBn is determined by the following:

RBn = (load impact x avoided cost) x (net to gross ratio)

RBn = first year impact x EUL x TDF

Where: EUL= Effective Useful Life (as determined by retention study)
TDF= Technical Degradation Factor (determined by technical performance studies)

Utility claims and their components, such as RBn, are presented in a format called "E-tables," which are standardized in the DSM Measurement Protocols Appendix E. E-tables are presented by the utilities in AEAP filings to substantiate their claims. Retention studies are cited in Table E-3 titled "Components of Resource Benefit Values." Utilities present Table E-3 for each sector, which itemize the energy savings and benefits for each end use. The tables also cite the required persistence studies for each claim. This citation is where retention studies are linked to earnings claims.

5.2.2 Methodology for assigning dollar values to retention studies

In order to assign dollar values to each of the reviewed retention studies, the E tables from AEAP filings 1999-2003 were used.[21] Recorded Costs and Benefits for Shareholder Incentives Programs (Tables E-2) and Components of Resource Benefit Values (Tables E-3) present benefits by end use for each sector. Because the RBn is revised for each earnings claim, it was critical to use the RBn for the earnings claim related to each retention study. The line "Revised

[18] Protocols, table 10, p 31
[19] protocols, table 10, p 31 and 32
[20] Utility claims, which are submitted in E-table 1, are aggregated at the sector level, while retention studies focus on end-uses and measures at the program level. Therefore a claim represents more than the dollar amount associated with an individual retention study.
[21] Citations for each of the utilities filings for each year- are included in this chapter in Table 4.1.

Net Resource Benefits," from Table E-2 in each AEAP filing was used to assign a dollar value to each retention study related to a third earnings claim.[22] The dollar amount associated with each study is the sum of the Revised Resource Benefit, net values in Table E-2 for all end uses and sectors associated with each study. In order to determine which end-uses, and therefore which Revised Net Resource Benefits values should be aggregated, table E-3 "Components of Resource Benefit Value," was used. This is noteworthy because many of the retention studies covered multiple sectors and multiple end uses.

The list of required persistence studies for each end use, as presented in Table E-3, was used to determine which benefits were linked to each retention study. The list of end uses was then compared to the end uses and measures reviewed in each retention study. Discrepancies, if any, were noted. However, in calculating the total RBn associated with each retention study, the E-tables were the ultimate source; the contents of the retention studies were used to verify the information presented in the E-tables.

Many of the retention studies were used to calculate the RBn in more than one sector. In this case, the final dollar value assigned to the retention studies includes the revised RBn for each end use and sector related to the retention study. In this manner, although the RBn in any individual sector may have been small, if the retention study was used to calculate the RBn in many sectors, the final dollar amount is much larger because it is the sum of benefits from all the sectors.

5.2.3 Estimation of RBn related to 4th earnings claim

In the case of retention studies tied to 4th earnings claims, although the studies have been completed, the RBn have not yet been filed in E-tables. These retention studies are tied to the 4th, and final earnings claim associated with these programs, and have yet to be filed. Therefore, these retention studies represent the culmination of the program's activities, and the final opportunity to adjust the RBn and total earnings. The fourth earning claim is the last installment of earnings; it is also dependent on the amount collected in the first three earnings claims. The fourth earnings claim is calculated based on the utility's share of the savings minus the amount paid in prior claims.

Because the 4th earnings claims have not yet been filed, the E-tables containing the revised RBn have not yet been filed. However, using the results of the retention studies it is possible to estimate RBn. The estimate depends on the realization rate for the EUL for end use measures. For example, if the realization rate equals one (adopted ex-post = ex-ante), then the revised RBn is unchanged from the 3rd earnings claim. In these cases, we estimated the resource benefit, net to be proportional to the third earnings claim. The multiplier depends on the realization rate for the EUL for end use measures. For example, if the realization rate equals one (adopted ex-post = ex-ante), then the resource benefit, net would be the same as it was for the 3rd earnings claim. If the EUL for any measure included in the study has changed, we adjust the dollar value of the resource benefit to reflect those changes. If the EUL for any measures included in the study has changed, the RBn is adjusted to reflect those changes.

[22] E-tables are filed in AEAP filings for claim years; because the fourth earnings claim have not yet been made, the E-tables have not yet been filed. The RBn dollar values for fourth earnings claims are estimates.

5.2.4 E-table Sources

The E-tables from a number of AEAP filings were used to support the RBn estimation work and estimated dollar assignments, and they are detailed in Table 5.1.

Table 5.1. AEAP Filings Used to Estimate Net Resource Benefits

Southern California Edison: • "Appendix E," Testimony of Southern California Edicaon Company in Support of Pre-1998 Demand-Side Management, 2000 Energy Efficiency, and 1999 and 2000 Low Income Energy Efficiency Earnings Claims, 2001 Annual Earnings Assessment Proceeding before the Public Utilities Commission of the State of California, Rosemead, California, May 1, 2001. • "Appendix E," Testimony of Southern Claifornia Edison Company in Support of Pre-1998 Demand Side Management and 2001 and 2002 Low Income Energy Efficiency Earnings Claims and 2002 Energy Efficiency Program Performance Achievements, 2003 Annual Assessment Proceeding, before the Public Utilities Commission of the State of California, Rosemead, California, May 1, 2003. • "Appendix E," Testimony of Southern California Edison Company in Support of Pre-1998 Demand-Side Management, 1999 Energy Efficiency, and 1998 and 1999 Low Income Energy Efficiency Earnings Claims, 2003 Annual Assessment Proceeding, before the Public Utilities Commission of the State of California, Rosemead, California, May 1, 2000. • "Appendix E," Testimony of Southern California Edison Company in Support of Pre-1998 Demand Side Management, 2001 Energy Efficiency, and 2000 and 2001 Low Income Energy Efficiency Earnings Claims, 2002 Annual Earnings Assessment Proceeding before the Public Utilities Commission of the State of California, Rosemead, California, May 1, 2002. • Testimony of Southern California Edison Company in Support of 1999 DSM and Energy Efficiency Earnings Claims, 1999 Annual Earnings Assessment Proceeding before Public Utilities Commission of the State of California, Rosemead, California, May 3, 1999.
San Diego Gas and Electric: • "Appendix A," Application, AEAP 1999 • "Appendix A," Application, AEAP 2000 • "Appendix A," Application, AEAP 2001 • "Appendix A," Application, AEAP 2002
Southern California Gas: • 2000 Application, AEAP 2000 • 2001 Application, AEAP 2001
Pacific Gas and Electric: • "Volume II," Annual Summary Report on Demand Side Management Programs Pre-1998, 2000 Annual Assessment Proceeding, May 1, 2000. • "Volume II," Annual Summary Report on Demand Side Management Programs Pre-1998, 2001 Annual Assessment Proceeding, May 1, 2001. • "Volume II," Annual Summary Report on Demand Side Management Programs Pre-1998, 2002 Annual Assessment Proceeding, May 1, 2002.

6 RETENTION STUDY REVIEW: RESULTS AND RANKINGS

The results of the evaluations are summarized in this section. First, the results prior to the assignment of dollars are presented. Then, the results from the analysis including dollar assignments are presented.

6.1 Analysis of Results Independent of Dollars at Risk

SERA and Quantec reviewed 54 unique retention studies reports from 4 different California utilities. The studies were submitted from 1999 to 2003. They covered program years 1993 through 1999, with some reported as program year 2002 or later. They were conducted as 3rd, 4th, 6th, or 9th year retention studies. Most of the studies combined 2 program years per the instructions presented in the Protocols and Procedures for the Verification of Costs, Benefits, and Shareholder Earnings from Demand-Side Management Programs. This summary presents some of the findings from the review of the retention studies.

Table 6.1 shows the number of unique retention studies for each sector.

Table 6.1. Sectors Covered by the Retention Studies

Sector	Total studies reviewed	Percent
Agricultural	7	13%
Commercial	8	15%
Commercial/Industrial / Military	3	6%
Commercial/Industrial/Agricultural	4	7%
Industrial	7	13%
Industrial/Agricultural	1	2%
Non-Residential New Construction	3	6%
Residential	20	37%
Residential Commercial/Industrial	1	2%
Total	54	100%

Most of the retention studies were done for the residential sector, followed by industrial and agricultural sectors.

As part of the review, we assigned scores to various aspects of the study. Scores range from 1 to 5, with 5 being the "best". A score of 3 means that the criteria were just met. The first score related to how well the protocol on the number of measures to be included in the study was addressed. We evaluated whether the criteria of the top 10 measures or 50% of savings was discussed, and whether the criteria were met. The distribution of the scores is presented in Table 6.2.

Table 6.2. CPUC Protocol Scores

Score	Number	Percent
1	1	2%
2	2	4%
2.5	2	4%
3	26	48%
3.5	16	30%
4	4	7%
4.5	3	6%
Total	54	100%
Average	3.21	

All but about 10% of the retention studies addressed the protocol requirement with at least a minimally satisfactory discussion. For the studies that did not, they either did not address the protocol or it was unclear whether they criterion was met. About half just met the criteria.

The scores for the sampling strategy review are presented in Table 6.3. We evaluated the sampling strategy (e.g. whether it was stratified, random, etc.), the sampling basis. (i.e., customers, rebates, installations, etc.), and any problems with the strategy / basis.

Table 6.3. Strategy Basis Scores

Score	Number	Percent
2.5	3	6%
3	26	48%
3.5	2	4%
4	19	35%
4.5	3	6%
5	1	2%
Total	54	100%
Average	3.46	

All but three studies had satisfactory sampling strategy and basis. One that did not had some difficulty in obtaining the addresses and names of participants.

In reviewing the retention studies, the fieldwork and validation of the data were also evaluated. Table 6.4 presents the scores for the fieldwork and validation of the data.

Table 6.4. Fieldwork and Validation Scores

Score	Number	Percent
2	3	6%
3	30	56%
3.5	1	2%
4	15	28%
4.8	3	6%
5	1	2%
Total	54	100%
Average	3.39	

The vast majority of the studies were satisfactory in their fieldwork and validation of data; 19 were considered good or very good. The three studies that received a 2 did not discuss how the fieldwork was conducted or data was validated.

We evaluated the adequacy of the methodology and what methodology and modeling was implemented in the study. The scores for methodology are shown in Table 6.5 below.

Table 6.5. Methodology Scores

Score	Number	Percent
2	14	26%
2.5	8	15%
3	10	19%
3.5	2	4%
4	14	26%
4.5	4	7%
5	2	4%
Total	54	100%
Average	3.13	

Some studies were very thorough in terms of the extent of their modeling. These studies often considered:

- Alternative models with good justification of final model chosen
- Statistical description of the failure data
- Treated failures and removals differently but included both in the analysis.
- Good discussion the estimates, results and model chosen.

A total of 22 of the retention studies received a score of 2.5 or less.

- These studies often did not consider alternative model selection.
- They provided little or no justification for the model they chose to estimate the EUL.
- They had a poor (or no) discussion of their estimates from their model.
- They did not present statistical information on the number of failures for the sample.

The total score (unweighted and combined for each retention study) is shown in Figure 5.1.

Table 6.6. Distribution of Total Scores

Score	Number	Percent
9	1	2%
10	1	2%
11	2	4%
11.5	5	9%
12	12	22%
13	13	24%
13.5	4	7%
14	6	11%
14.5	3	6%
15	2	4%
15.5	1	2%
16	1	2%
17	1	2%

Score	Number	Percent
17.8	1	2%
18	2	4%
Total	54	100%
Average	13.19	

A total of 9 of the studies had a total score less than 12. These corresponded to the studies that also had poor methodology. The overall score for the realization rate retention studies were scaled so that a comparison to other retention studies could be made.

Another criterion that was used to evaluate the retention studies was to examine the realization rate for the EULs. The realization rate is the ratio of the *ex post* EUL to the *ex ante* EUL.

We identified studies that had a realization rate (ex-post adopted value/ex-ante value) greater than 1 for any measure included in the study, less than one for any measure and none greater than one for any measure in the study, and equal to one for all measures included in the study. Studies that found realization rates greater than 1, were flagged, especially if that conclusion was not well justified. A realization rate greater than one would be expected to translate into a higher dollar amount claimed for that program. We found:

- 14 studies had at least one measure where the *ex post* adopted value was greater than the *ex ante* value
- 6 studies had at least one measure where the *ex post* adopted value was less than the *ex ante* value and none greater than the ex-ante value.
- 34 studies had all measures use the *ex ante* values as the adopted *ex post* value.

Table 6.7 lists the studies with measures that had realization rates greater than one.

Table 6.7. Realization Rates for Selected Studies/Measures

Realization Rate	Measure(s)	Study ID	Utility	Nth Year Retention Study	Program Years
1.07	CFL Bulbs	R2	SDG&E	6	1994 & 1995
1.17	CFL Bulbs & Fixtures	R5	SDG&E	6	1996 & 1997
1.36	CFL Bulbs & Fixtures	R3	SDG&E	4	1994 & 1995
1.6	CFL, HID, T-8	R10	PG&E	6	1994 & 1995
2.6	Ballasts & CFL lamps	CIA1	SCE	4	1993 & 1994
2.88	CFL Lamps	CIA2	SCE	6	1993, 1994, 1996, & 1997
3.04	Heat Curtain	A4	PG&E	6	1994 & 1995
5.78	LPD	NRNC2	SDG&E	4	1996 & 1997
9	Optical Reflector & CFL Bulbs	C1	SDG&E	4	1996 & 1997
9.47	Occupancy Sensors & Lighting	C2	SDG&E	4	1996 & 1997
10.345	Exit Sign Kit (LED)	I2	SDG&E	4	1994 & 1995

Some of these studies were well justified in using an *ex post* value greater than one. Other studies suggested that some of the measures would be in place for 50 years or more and were not well justified in their claims, especially for a 4th year retention study. These factors were taken into consideration in the analysis included in Chapter 7.

6.1.1 Re-evaluation of Selected Retention Studies

Based on the rankings, some studies were selected for additional analysis and re-evaluation of the results. These studies were selected based on the overall grade they received and the dollars associated with the study. There were 14 studies that received a C- or lower. The 14 studies that received a grade of C- or less were evaluated again. Those studies that were originally reviewed by SERA were then re-evaluated by Quantec; and the studies that were originally done by Quantec, were reviewed again by SERA. This was done to confirm that the studies were of lower quality, and were candidates for further evaluation.

6.2 Results Including Resource Benefit Dollars

Early on, it was determined that financial issues would be one of the most important factors driving the prioritization of the retention study work. Beyond dollars, other factors would also be considered, including priority programs or sectors, or other criteria.

The estimated dollars (estimated per Chapter 4) represented by the future stream of energy saved from the measures associated with the retention study's program,[23] shows the following:

- The value of the total resource benefits, net associated with the retention studies varied from more than $180 million (for a Commercial Energy Efficiency Incentives program at SDG&E and another at PG&E) to a low of $203,000 for an agricultural sector program. The average of the "total resource benefits, net" is about $41 million (in 1997 dollars) across the 54 retention studies.

- There is significant concentration in these benefits. The top 5 studies account for 42% of the resource benefits, net; the top 10 studies account for 70% of the benefit dollars. The total dollars reflected are $2.22 billion ($2,217,908,000). These results are illustrated in Table 6.8.

[23] Note, of course, that the dollar values associated with the programs are influenced by the expected lifetimes of the measures, as well as the sector, participants, etc.

Table 6.8. Ranking of Resource Benefit net (RBn) Dollars

Rank	RBn for Study	Cumulative RBn$	Cumulative % of Total RBn$
1	$184,820,000	$184,820,000	8%
2	$184,820,000	$369,640,000	17%
3	$181,197,000	$550,837,000	25%
4	$165,024,000	$715,861,000	32%
5	$165,024,000	$880,885,000	40%
6	$139,190,000	$1,020,075,000	46%
7	$137,835,000	$1,157,910,000	52%
8	$121,095,000	$1,279,005,000	58%
9	$118,490,000	$1,397,495,000	63%
10	$116,255,000	$1,513,750,000	68%
11	$85,808,000	$1,599,558,000	72%
12	$64,035,000	$1,663,593,000	75%
13	$46,514,000	$1,710,107,000	77%
All studies		$2,217,908,000	

The percent of the dollars by utility and by retention study sector are shown below. Table 6.9 also shows the average score by utility and the average dollars of benefits for each of the four utilities. The three main utilities had very similar total dollars; however the average dollars per report for the utilities varied dramatically. The percent of dollars by sector are shown in Table 6.10.

Table 6.9. Percent of Dollars by Utility and Retention Study

Utility	SDG&E	SCE	PG&E	SCG	Total
Percent of total resource benefits, net	43.2%	33.7%	23.0%	0.1%	100%
Average grade by utility	3.08	3.86	3.98	3.78	3.49
Average grade score by utility (5 point scale)	3.33	3.75	3.53	3.50	3.46
Average score fielding	3.22	3.91	3.38	3.50	3.39
Average score methodology	2.37	3.69	4.06	3.50	3.13
Average score protocols	3.30	3.06	3.00	4.00	3.21
Average score total	12.22	14.41	13.97	14.50	13.19
Total dollars by utility	$957,632K	$747,824K	$509,970K	$2,575K	$2,217,908K
Average dollars per utility	$36,832K	$106,832K	$33,988K	$1,287K	$41,072K
Count of studies by utility	26	7	15	2	54

Table 6.10. Percent of Resource Benefit net (RBn) Dollars by Sector

Sector	Average RBn$	Number of Studies	Total Resource Benefit net Dollars	% of RBn$
Agricultural	$6,415,857	7	$44,911,000	2.0%
Commercial	$104,360,571	7	$730,524,000	32.9%
Comm/Ind/Ag	$142,408,000	4	$569,632,000	25.7%
Comm/Ind/Military	$100,935,000	2	$201,870,000	9.1%
Industrial	$35,193,000	7	$246,351,000	11.1%
Industrial/Ag	$116,255,000	1	$116,255,000	5.2%
Non-Res New Construction	$36,150,000	3	$108,450,000	4.9%
Residential	$11,024,000	18	$198,432,000	8.9%
Resid/Comm'l	$1,517,000	1	$1,517,000	0.1%

The average dollars associated with studies receiving different grades are shown below. One high value, but poorly graded study affected the results, but without that study, there is a clear relationship between higher dollar values and higher quality reports. In the tables below, we also provide the average dollars for ranges of total quality scores (which ranged from 9-18 total points).

Table 6.11. Summary of Retention Study Dollars by Grade

Average Grade	Translation of Grade to Numeric Score	Number of Studies	Average Resource Benefit Net $	Total Resource Benefit Net $	% of Total Resource Benefit Net
A	5.00		$0	$0	0.0%
A-	4.67	3	$134,125,000	$402,375,000	18.1%
B+	4.33	5	$45,359,000	$226,795,000	10.2%
B	4.00	15	$58,058,000	$870,870,000	39.3%
B-	3.67		$0	$0	0.0%
C+	3.33	3	$2,664,000	$7,992,000	0.4%
C	3.00	10	$24,288,400	$242,884,000	11.0%
C-	2.67	12	$26,666,000	$319,992,000	14.4%
D+	2.33	1	$28,510,000	$28,510,000	1.3%
D+	2.00	1	$118,490,000	$118,490,000	5.3%

Table 6.12. Summary of Retention Study Dollars by Total Technical Score

Score Total	Number of Studies	Average Resource Benefit Net $	Total Resource Benefit Net $	% of Total Resource Benefit Net
18	1	$165,024,000	$165,024,000	7.4%
17.8	1	$121,095,000	$121,095,000	5.5%
17	1	$11,302,000	$11,302,000	0.5%
16	1	$165,024,000	$165,024,000	7.4%
15.5	1	$4,077,000	$4,077,000	0.2%
15	3	$101,939,000	$305,817,000	13.8%
14	5	$26,103,000	$130,515,000	5.9%
13.5	4	$10,091,000	$40,364,000	1.8%
13	12	$75,174,583	$902,095,000	40.7%
12	12	$12,467,917	$149,615,000	6.7%
11.5	5	$16,892,000	$84,460,000	3.8%
11	2	$101,000	$202,000	0.0%
10	1	$19,835,000	$19,835,000	0.9%
9	1	$118,490,000	$118,490,000	5.3%

Table 6.13. Summary of Retention Study Dollars by Score for Methodology Criteria

Method Score	Number of Studies	Average Resource Benefit Net $	Total Resource Benefit Net $	% of Total Resource Benefit Net
5	1	$118,197,000	$118,197,000	5.3%
4.5	2	$66,199,000	$132,398,000	6.0%
4	14	$51,557,000	$721,798,000	32.5%
3.5	2	$20,910,000	$41,820,000	1.9%
3	10	$11,291,700	$112,917,000	5.1%
2.5	8	$67,793,875	$542,351,000	24.5%
2	13	$37,340,000	$485,420,000	21.9%

There is a pattern in "grades" of the assessed quality of the retention studies. We found that the highest value programs tended to have retention studies that were more carefully done. The Utilities appear to have reacted to financial incentives; retention studies of poorer quality tended to be associated with the lower valued programs. Note that the initial quality review assessments were conducted independently of knowledge of the dollars or importance of the programs.

While higher valued programs tended to have higher quality studies, we found several studies that were candidates for re-assessment related to their poor score and high dollars. For example, one of the retention studies with the highest value received only a "C-" (line 1), while another high dollar study received a "D" grade in the initial quality review process.

The analysis showed that there were significant dollars potentially "at risk" associated with studies with low quality scores. Those with fewer than 12 points (9 studies) represent more than $223 million in total resource benefits, net. Those with scores lower than a 12.5 (21 studies) point total represented about resource benefits, net, totaling $1,139K; and those receiving a C- or lower (14 studies) represent almost $467 million in total resource dollars, net.

The study id, utility, grade, score, and dollars associated with each of the studies are listed in Table 6.14 below.

Table 6.14. Ranking of Retention Studies by "Resource Benefit net" Values

Report Number	Title	Utility Covered	Sector(s) Covered	Dates Covered / AEAP Year	Sum of all Scores	Evalua -tion score / A-F	Dollars (thousands) claimed on Appendix E
925 & 961	1994 & 1995 Commercial Energy Efficiency Incentives. Ninth Year Retention Evaluation	SDGE	Commercial	1994 and 1995 / 2004	13	B	184,820
924 & 960	1994 & 1995 Commercial Energy Efficiency Incentives. Fourth Year Retention Evaluation	SDGE	Commercial	1994 and 1995 / 1999	13	C-	184,820
349R1, 351R1	Fourth Year Retention Study for PG&E's 1996 &1997 Commercial EEI Program Lighting and HVAC Technologies	PGE	Commercial	1996 & 1997 / 2001	15	B	181,197
529	SCE 93-94 C/I/A Energy Efficiciency Incentive Pgm	SCE	C/I/A	Measures installed in 93/94. Fourth year retention study	18	A-	165,024
547	Southern California Edison Commercial/Industrial/Agricultural Energy Effeciency Incentives Program Retention Study	SCE	Commercial /Industrial /Agricultural	1993-1994 / 2004	16	B+	165,024
993 & 1017	1996 & 1997 Commercial Energy Efficiency Incentives. Fourth Year Retention Evaluation	SDGE	Commercial	1996 & 1997 / 2001	13	C	139,190
1005	1996&1997 Non Res New Construction	SDGE	Non Res / Commercial, Industrial, military	1996 and 1997 / 2001	13	B	137,835
553	Southern California Edison Commercial/Industrial/Agricultural Energy Efficiency Incentives Program Retention Study.	SCE	C/I/A	1993, 1994, 1996 & 1997 / 2001	17.8	A-	121,095
555	Southern California Edison 1996 and 1997 Nonresidential DSM Bidding Retention Study	SCE	Commercial /Industrial /Agricultural	1996 & 1997 / 2001	9	D	118,490
547 B&C, 558 B&C	Southern California Edison Commercial/Industrial/Agricultural Energy Efficiency Incentive Program Retention Study (Sixth Year Report for Program Years 1993-1997)	SCE	Industrial /Agricultural	1993, 1994, 1996, 1997 / 2003	15	A-	116,255
311R2,382 R2,, 314R2, 325R2	1994 and 1995 Industrial Energy Efficiency Incentive Programs Sixth-Year Retention Study	PGE	Industrial	1994 and 1995 / 2001	13	B	85,808

Report Number	Title	Utility Covered	Sector(s) Covered	Dates Covered / AEAP Year	Sum of all Scores	Evalua -tion score / A-F	Dollars (thousands) claimed on Appendix E
936&972	1994&1995 Non Res New Construction Fourth Year	SDGE	Non Res / Commercial, Industrial, military	1994 and 1995 / 1999	13	B	64,035
323R2, 424R1	PG&E's Program Year 1994-1995 Ninth Year Non Residential New Construction Retention Study	PGE	NRNC	1994 and 1996 /	14	B	46,514
353R2, 334aR2, 350R1, 334bR1	Retention Study of Pacific Gas and Electric Company's 1996 & 1997 Industrial Energy Efficiency Incentive Programs	PGE	Industrial	1996 and 1997 / 2003	13	B	38,026
353R1, 334abR1, 350R1	Retention Study of Pacific Gas and Electric Company's 1996 & 1997 Industrial Energy Efficiency Incentive Programs	PGE	Industrial	1996 and 1997 / 2001	14	B+	38,026
310R2, 324R2, 312R2 and 326R2	Ninth Year Retention Study for PG&E's 1994 and 1995 Commercial EEI Program Lighting and HVAC Technologies	PGE	Commercial	1994 and 1995 / 2004	14	B	37,921
530/554	Non-Residential New Construction Persistence Study	SCE	Non-Res New Construction	1994 and 1996 / 1999	12	C	34,619
985	1996 & 1997 Residential Appliance Efficiency Incentives Program: Compact Fluorescent Lights Sixth Year Retention Evaluation	SDGE	Residential	1996 & 1997 / 2003	12	C-	31,292
928, 964	1994 & 1995 Industrial Energy Efficiency Incentives Program Sixth-Year Retention Study	SDGE	Industrial	1994 & 1995 / 2001	12	C	30,672
922	1994 & 1995 Residential Appliance Efficiency Incentives Program: Compact Fluorescent Lights: Sixth year Retention Study	SDGE	Residential	1994 & 1995 / 2001	12.5	C-	30,506
921	1994 & 1995 Residential Appliance efficiency Incentives: Compact Fluorescent Lights. Fourth Year Retention Evaluation	SDGE	Residential	1994 & 1995 / 1999	11.5	D+	28,510
548, 559	Southern California Edison's PY 1994-1996 Ninth Year Non-Residential New Construction Retention Study (Final Report)	SCE	Non-Res New Construction	1994-1996 / 2004	13.5	B	27,316
996, 1020	Industrial Energy Efficiency Incentives Program Fourth Year Evaluation	SDGE	Industrial	1996 and 1997 / 2001	13	B	25,881
927, 963	1994 & 1995 Industrial Energy Efficiency Incentives Program Fourth-Year Retention Study	SDGE	Industrial	1994 & 1995 / 1999	12	C	21,261

Report Number	Title	Utility Covered	Sector(s) Covered	Dates Covered / AEAP Year	Sum of all Scores	Evalua -tion score / A-F	Dollars (thousands) claimed on Appendix E
984	1996 & 1997 Residential Appliance Efficiency Incentives Program: Compact Fluorescent Lights Fourth Year Retention Evaluation	SDGE	Residential	1996 and 1997 / 2001	11.5	C-	20,587
315R2, 321R2, 329R2, 331R2	6th Year Retention Study of Pacific Gas and Electric's 1994 and 1995 Energy Efficiency Incentives Programs, Agricultural Sector Measures	PGE	Agricultural	1994&1995 / 2000	10	C-	19,835
915	1994 & 1995 Residential Appliance efficiency Incentives: Refrigerator. Fourth Year Retention Evaluation	SDGE	Residential	1994 and 1995 / 1999	12	C-	13,945
916	1994 & 1995 Residential Appliance efficiency Incentives: Refrigerator. Ninth Year Retention Evaluation	SDGE	Residential	1994 and 1995 / 1999	12	C-	13,945
981	1996 & 1997 Residential Appliance Efficiency Incentives: Refrigerators	SDGE	Residential	1996 & 1997 / 2001	13	C	13,263
372R1	Retention Study of Pacific Gas and Electric Company's Efficiency Incentives Program. Final Report. 1996 Residential Lighting Third Year Retention	PGE	Residential	1996 / 2001	17	B+	11,302
354R1, 385R1, 335abcR1	3rd Year Evaluation of Retention in Pacific Gas & Electric Company's 1996 (and 1997) Agricultural Energy Efficiency Incentives (AEEI) Program	PGE	Agricultural	1996 and 1997 / 2001	13	B	10,869
354R2, 385R2, 335AR2, 335BR2, 335CR2	6th Year Retention Study of Pacific Gas and Electric's 1996 and 1997 Energy Efficiency Incentives Programs, Agricultural Sector Measures	PGE	Agricultural	1996&1997 / 2000	13	B	10,869
384R2, 401bR2	1994-1995 Residential Lighting Sixth Year Retention Study	PGE	Residential	1994 & 1996 / 2001	13.5	B	8,955
373 1R1	Fourth Year Retention Study for PG&E's 1996 &1997 Residential AEI Program Refrigeration Technology	PGE	Residential	1996 & 1997 / 2001	15	B+	8,366
997, 1021	Industrial Energy Efficiency Incentives Program Sixth Year Evaluation	SDGE	Industrial	1996 and 1997 / 2003	13	B	6,676
933	1994 & 1995 Residential New Construction Program: Fourth Year Retention Evaluation	SDGE	Residential	1994 & 1995 / 1999	11.5	C-	4,859

Report Number	Title	Utility Covered	Sector(s) Covered	Dates Covered / AEAP Year	Sum of all Scores	Evalua -tion score / A-F	Dollars (thousands) claimed on Appendix E
384cR2	Ninth Year Retention Study for PG&E's 1994 & 1995 Residential AEI Program Air Conditioning Technology	PGE	Residential	1994 & 1995	14	B	4,153
322R2	PG&E's Program Year 1994/1995 Residential New Construction 9th Year Retention Study	PGE	Residential	1994 & 1995	15.5	B+	4,077
386R1	4th Year Retention Study of Pacific Gas & Electric company's 1996 and 1997 Residential New Construction Program Final Report	PGE	Residential	1996 and 1997/ 2001	14	C+	3,899
720	Measure Retention Study of the 1996 Commercial EEI Program	SCG	Commercial	1996 / AEAP 2000	13.5	C+	2,575
1026	1997 Fuel Substitution Program	SDGE	Residential / Commercial ?	1997 / AEAP 2002	13.5	C+	1,517
1000, 1024	1996 & 1997 Agricultural Energy Efficiency Incentives Program Sixth-Year Retention Evaluation	SDGE	Agricultural	1996 & 1997 / 2002	12	C	1,116
999 and 1023	1996 & 1997 Agricultural Energy Efficiency Incentives: Fourth Year Retention Evaluation	SDGE	Agricultural	1996 and 1997 / 2001	12	C	1,116
931 and 967	1994 & 1995 Agricultural Energy Efficiency Incentives: Sixth-Year Retention Evaluation	SDGE	Agricultural	1994 and 1995 / 2001	12	C	870
1002	1996 Residential New Construction Program	SDGE	Residential	1996 / 2001	12	C	774
930, 966	1994 & 1995 Agricultural Energy Efficiency Incentives, Fourth Year Retention Study	SDGE	Agriculture	1994 & 1995 / 1998	11	C-	203
718	95 Coml New Construction Program (4th yr retention)	SCG	Commercial Kitchens	1995 / 2000	12	C	-
958	1995 Residential Weatherization Retrofit Incentives Ninth Year Retention Evaluation	SDGE	Residential	1995 / 1999	11.5	C-	-
990	1996 & 1997 Measure Retention Study Residential Weatherization Retrofit Incentive (RWRI) Program	SDGE	Residential	1996 & 1997 / 2001	12	C-	-
945 & 970	1994 & 1995 Residential New Construction Program: Ninth Year Retention Evaluation	SDGE	Residential	1994 & 1995 / 1999	11	C-	-
716A	1994 Residential New Construction Ninth-Year Retention Evaluation (Energy Advantage Home Program), Study Number 716A)	SCG	Residential	1994 /	18	A	

Report Number	Title	Utility Covered	Sector(s) Covered	Dates Covered / AEAP Year	Sum of all Scores	Evalua -tion score / A-F	Dollars (thousands) claimed on Appendix E
937&973	1994&1995 Non Res New Construction fourth yr	SDGE	Non Res / Commercial, Industrial, military	1994 and 1995 / 2004	13	B	
384aR2	Ninth Year Retention Study for PG&E's 1994 & 1995 Residential AEI Program Refrigeration Technology	PGE	Residential	1994 & 1995 /	15.5	B+	
529D	1994 Commercial CFL Manufacturers' Rebate Persistence Study	SCE	Commercial	1994 / 1999	14	B+	
Table Notes: (*) Retention Studies for which the 4th earnings claim has not yet been filed., $0 means we could not find a reference to this report in any of the filing reviews							

6.3 Technical Review Worksheet

Detailed evaluations, scores, rationales, and results associated with each individual study are included in the Technical Review Spreadsheet, which is provided under separate cover as an Excel spreadsheet entitled Attachment B.

6.4 Realization Rate Studies

The SERA team also reviewed six realization rate studies. As shown in Table 6.15, each of these studies was for the PG&E Power Savings Partners Program. The methodology was consistent for each report, requiring that each Partner (the companies managing winning bidding contracts) conduct extensive site visit verification, including metering. All data were analyzed by both PG&E and a third party, independent consultant. The realization rates derived from these studies are then used to adjust the Program savings estimates.

These studies were all assigned a letter grade of "B." While they provided extensive details about the realization rates (by partner, measure, sector, etc.) and stated that the protocols were met, detailed information about *how* the protocols were met were only included in an appendix with annual reports from each partner. The body of the reports, or an additional appendix, could have succinctly summarized the data collection activities, including the number of site visits and type and length of metering per Partner/project.

Table 6.15. Summary of Realization Rate Studies

Report number	Title of Study	Date of Report	Utility Covered	Name of Program	Sector(s) covered	Measures covered by the program / measures included in the study. [Description]	Dates for measures / Year AEAP was filed	Number of Site/ End uses/ Partners
396R1 a,b,c,d,e,f	3rd Earnings Claim - Realization Study of Power Savings Partner's Program	March-01	PG&E	Power Savings Partners	Commercial /Residential	Res Lighting, Comm Lighting, Indus Process, Comm HVAC, Comm Refrig, Res Gas Boilers	1996 / 2001	435 site/ end use combinations from 8 partners
398R1a,b,c, d,e,f,g	3rd Year Earnings claim Realization Rate Study. Program Year 1997	April-02	PG&E	Power Savings Partners	Commercial /Industrial/Residential	Comm Lighting (PSP I and II), Comm Gas Boilers, Ind Process (PSP I and II), Res lighting, Res gas boilers	1997 / 1998	228 site/ end use combinations from 11 partners
399R2	3rd Earnings Claim - Realization Study of Power Savings Partner's Program	March-00	PG&E	Power Savings Partners	Commercial /Residential /Industrial	Comm lighting, Res lighting, Indus process	1995 /2000	136 site/ end use combinations from 8 partners.
425a, b and 426a, b, anc c	PY 2000 2nd Earnings claim Realiz Rate Study of the PSP	March-02	PG&E	Power Savings Partners	Commercial /Industrial	Comm lighting, Comm Traffic lighting, Comm hvac, Indus lighting, Indus process	2000 / 2002	45 site/ end use combinations from 4 partners.
399 R2	PY 1994 9th Year Retention Study PG&E PSP	March-04	PG&E	Power Savings Partners	Commercial	Commercial Lighting	1994 / 2004	39 site/ end use combinations from 5 partners.
422 a, b, c, d, e and 423 a, b, c	PY 1999 4th year retention study PG&E PSP	March-04	PG&E	Power Savings Partners	Commercial /Industrial	Comm lighting (PSP I and II), Comm Traffic lights (PSP II), Comm HVAC (PSP I and II), Indus process (PSP II), Indus lighting (PSP II), Indus motors (PSP II)	1999 / 2004	196 site/ end use combinations from 5 total partners.

7 Analysis of Dollars at Risk and Implications

The last efforts associated with the study were to assess the implications of the results – and derive methods to estimate the program dollars that are affected by the results. The results of the analyses are presented in this chapter:

- A review of the differences in *ex ante* and *ex post* EULs by measure types, with a goal toward bracketing the potential dollars at risk from poorer quality EUL estimates.
- A non-statistical analysis of the impact of the adjusted EULs on the final dollar amount claimed.
- A re-estimation of the EULs from studies with low scores for methodology using the original data collected by the utilities and their consultants.

This part of the analysis is still in progress. The first two methods were developed to help "bound" the dollars at risk because it was unclear whether the revised EUL analysis would be available.

7.1 Analysis of *ex ante* and *ex post* EULs by Measure Type

In order to estimate the difference in realization rates that can be applied to poor-performing studies and provide a helpful benchmark for future studies, the SERA team examined the volatility of the EULs across time and utilities. As shown in Table 7.1 and Table 7.2, the EULs were summarized across the retention studies based on sector, end use, and measure category. The studies with the largest number of dollars associated with them were primarily in the commercial and industrial sectors, with lighting being the most common end use. This study therefore examines the volatility of lighting measures in the commercial and industrial sectors.

For each stratum the mean, minimum, and maximum EULs were reported for the *ex ante*, final (accepted) *ex post*, and realization rates. For example, there were eight commercial lighting programs that estimated EULs for electronic ballasts (Table 7.1). The mean ex ante EUL was 15 years, with a minimum of 10 years and a maximum of 16 years. The average accepted *ex post* EUL, however, was 14 years, as at least one study accepted the ex post EUL and rejected the initial *ex ante* EUL (the minimum realization rate was 0.8).

There are a number of measures that show dramatic increases in the *ex ante* to *ex post*. For example, commercial de-lamping / reflector projects increase from an average EUL of 13 years to an average of 33 years; T8 lamps increase from an average EUL of 15 years to an average of 33 years; finally, the one commercial project with occupancy sensors jumped from an ex ante EUL of eight years to an ex post EUL of 76 years (Figure 7.1). A number of realization rates, in fact, are over 9 times the ex ante value.[24]

In the industrial sector most of the ex post lighting EULs were nearly identical to the ex ante values. Ballasts only showed a slight jump, from 12 to 16 years, while one study accepted an ex

[24] A discussion of high realization rates was previously addressed in Table 6.6 of this study.

post EUL of 207 years for occupancy sensors, thus pushing this average to 113 years, well above any reasonable estimate (Figure 7.2).

Table 7.1: EULs for Commercial Lighting Projects

		Ex ante			Final Ex post			Realization Rate		
Measure	Number of Studies	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max
Ballast	8	15	10	16	14	8	16	1.0	0.8	1.0
CF Fixture	7	13	10	16	13	10	16	1.0	1.0	1.0
CF Lamp	5	9	2	20	9	6	13	1.6	0.7	2.9
Delamping/Reflectors	7	13	10	16	33	10	154	2.2	1.0	9.6
Exit signs (LED)	1	20	20	20	20	20	20	1.0	1.0	1.0
HID Lighting*	1	16	16	16	16	16	16	1.0	1.0	1.0
HP Lighting*	2	18	15	20	18	15	20	1.0	1.0	1.0
Occupancy Sensors	1	8	8	8	76	76	76	9.5	9.5	9.5
T8 Fixture	3	13	11	16	13	11	16	1.0	1.0	1.0
T8 Lamp	9	15	5	20	33	5	91	1.9	1.0	4.5
T8 Lighting*	1	16	16	16	16	16	16	1.0	1.0	1.0

*Full lighting systems, with lamps and fixtures combined in same model

Table 7.2: EULs for Industrial Projects

		Ex ante			Final Ex post			Realization Rate		
Measure	Number of Studies	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max
Ballast	5	12	10	16	16	10	33	1	1	2
EMS	1	15	15	15	15	15	15	1	1	1
Exit signs (LED)	2	20	20	20	113	20	207	6	1	10
HID Fixture	1	16	16	16	16	16	16	1	1	1
HID Lighting*	3	17	16	20	17	16	20	1	1	1
T8 Fixture	6	13	11	16	13	11	16	1	1	1
T8 Lamp	11	16	5	20	16	5	20	1	1	1
T8 Lighting*	3	16	16	16	16	16	16	1	1	1

*Full lighting systems, with lamps and fixtures combined in same model

Figure 7.1. Ex ante and Final Ex post EULs for Commercial Lighting Projects

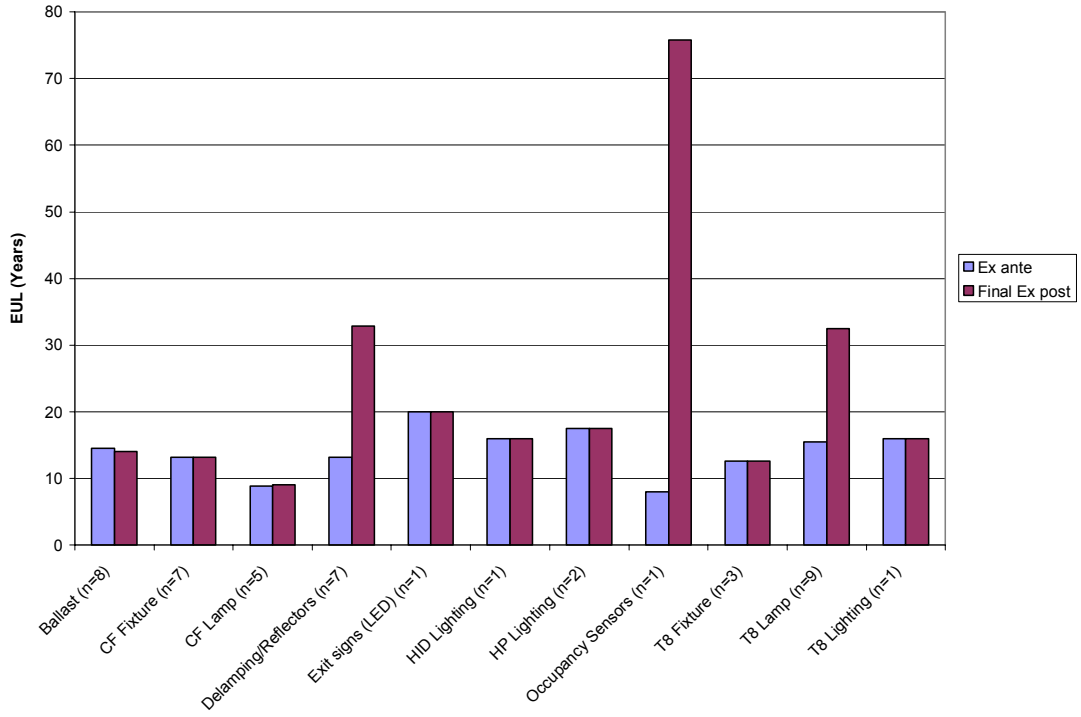
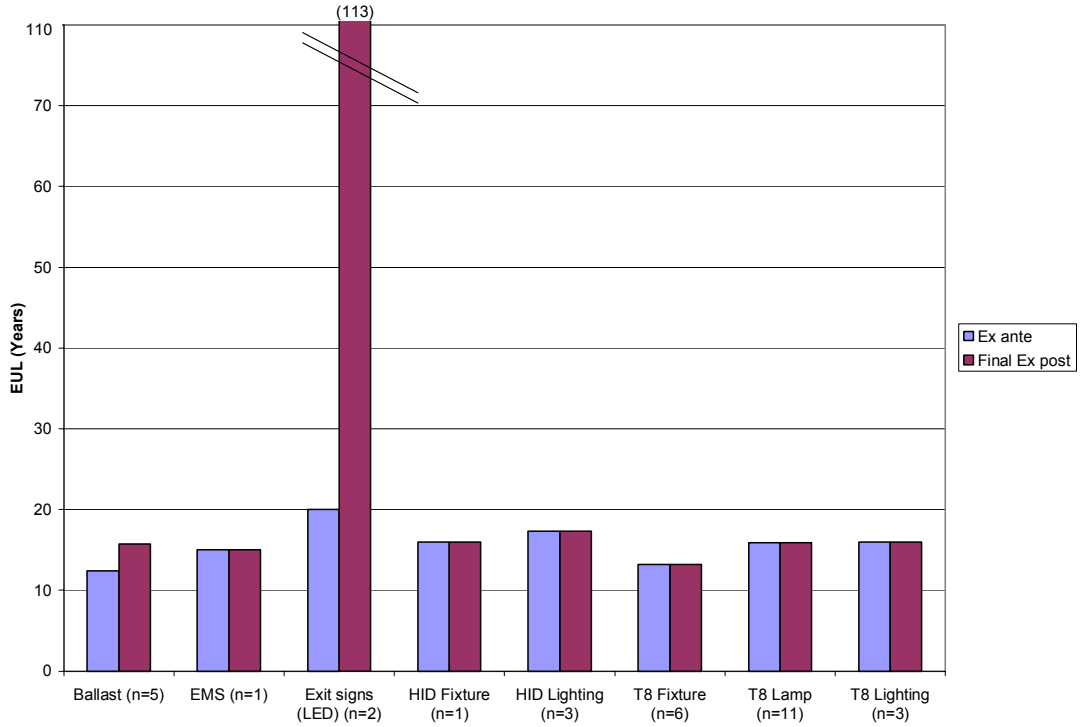


Figure 7.2. Ex ante and Final Ex post EULs for Industrial Lighting Projects



This work shows that some of the most common measures in the high dollar studies are accepting ex post values that are well above the ex ante values. These high realization rates have potential dollar implications for programs. Differences between ex ante value and *ex post* values derived from strong studies are being used to bracket the dollars at risk from the poorer scoring measure life studies.

This work indicates that the average final *ex post* EUL for T8 lamps is roughly double the *ex ante* value – a change with potential dollar implications for programs. Differences between ex ante value and *ex post* values derived from strong studies are being used to bracket the dollars at risk from the poorer scoring measure life studies.

7.2 Evaluating the impact of adjusted EULs on the final dollar amount claimed

We wanted to identify the impact in dollar terms that an incorrectly estimated EUL would have for the retention study and the resulting earnings claim. This section discusses a non-parametric approach for evaluating potential dollars at risk due to biased estimates of the EUL. One retention study is evaluated assuming that some of the EULs are incorrect; the dollar impact associated with this change in the EULs is then estimated.

The estimates of the expected useful life (EUL) of the measures are used by the utilities to support their claims for program savings. These program savings are translated from kWh into dollars and are used in the annual filings by the utilities.

The net resource benefit is the mechanism through which any changes to the EULs would impact the final dollars the utilities would claim. The net resource benefit, as it related to the EUL[25] is:

Net resource benefit = (First –year impact)x(Program-level EUL)x(Program-level TDF)

Where the TDF is the technical degradation factor: This multiplier accounts for the time and use related change in the energy savings of the high efficiency measure relative to a standard efficiency measure.

Changes in the Net resource benefit due to changes in the EUL would be:

$$\Delta\text{Net resource benefit} = (\text{First –year impact}) \times (\text{Program-level TDF}) \times \Delta(\text{EUL})$$

In evaluating the potential dollars associated with any estimates of the EULs that may not be reliable or well justified, we consider whether the ex post estimated value was greater than ex ante and what kind of effect that would have on the total dollars being claimed for the net resource benefit. There are potentially other cases to consider, but they are not likely to translate into dollar impacts.

Estimating the dollar impact for these cases requires identifying the following:

1) Which measures within each program do not appear to be accurate?
2) What are the *ex post* and *ex ante* values for these measures?
3) How many measures are in place? What is the population that exists for these measures?

[25] There is currently no discussion of discounting the savings over the expected useful life. This may be taken into account in updated computations.

4) What are the savings estimates for each measure in kWh per year?
5) What is the new net resource benefit using the *ex post* EUL?
6) What is the total value of the new net resource benefit for all measures in the population?
7) This should be done for each measure in the study/program that exceeds the *ex ante* value.
8) Convert kWh savings to dollars.
9) Compare these values to those claimed on the E-tables for the filings that appear to be relevant. For most cases, this should be the second and third earnings claim. The net resource benefit in the second earnings claim should reflect the use of the *ex ante* values, and the third earnings claim should reflect the use of the *ex post* values of the EUL.

Some issues arise in applying this non-parametric method to assess the EUL impacts.

- Information for Items 1-3 should be available in the retention studies, although not all studies reported the population of the installed measures. This information should also be available in the E-tables

- Item 4 may be in the E-tables at some level. Most of the retention studies do not provide this information, although E-tables present savings estimates at the end use level.

- Item 8: Convert kWh to dollars, and the E-tables present this information.

- Item 9: the description of the net resource benefit used in the E-table is defined by:

  RBn = (load impact x avoided cost) x (net to gross ratio)

- These claims reference the retention studies in support of the net resource benefit. Efforts to reconcile these two methods for calculating the RBn are an additional step.

7.2.1 Example

In testing this non-parametric approach to estimating the dollars at risk, we demonstrated the method on a worst case or "most dollars" study. Study ID 924 & 960 for the Commercial Energy Efficiency Incentives represented one of the highest net resource benefits claimed at $184,820,000 dollars for program years 1994 and 1995, plus had some of the highest realization rates associated with the EULs.

The study identified four measures that had *ex post* values greater than the *ex ante* values. These four measures accounted for 4 of the 6 lighting measures reviewed for program year 1994. These measures are also tied to "like measures" which are assumed to have the same EULs. The information available on these measures is summarized in Table 7.3 below.

Table 7.3. 1994 Lighting Measure Examined

Measure	Number of measures installed in Program	Realization Rate	*Ex ante*	*Ex post*
2FO32/1B4T8-2L/1R4-D2	39,170	4.53	20	90.6
2FO32/1B4T8-2L/1R4-D1	30,504	4.25	20	85.0
2FO32/1B4T8-2L	61,624	1.89	20	37.9
Occupancy Sensors	1,967	9.47	8	75.8
4FO32/1B4T8-2L	17,300	1.0	20	20
1CF13H	4,318	0.65	20	13.0
Total	**154,883**			

We do not have information on savings estimated for each measure. Therefore, for this example, we assumed that the measures have similar savings estimates.[26] Then we can look at the number of lighting measures installed that may be incorrect as a percent of the total lighting measures installed, and use that to calculate the net resource benefit that should be adjusted. In terms of the total number of lighting measures reviewed for program year 1994, 86% of the total measures installed in the program had ex post EULs greater than the ex ante values. The dollars claimed for end use lighting measures for program year 1994 was $33,557,000[27] net resource benefit; 86% of this number is $28,859,000.

Some simple estimates of impacts on net resource benefits follow. The worst-case scenario was for the realization rate to be 9.5 times too high. In this case, the net resource benefit for 1994 lighting measures should be as presented in Table 7.4.

Table 7.4. Adjustment to Net Resource Benefit for 1994 Lighting Measures: Method 1

Description	Calculation	Resulting impact on Net Resources Benefit
Dollars not affected[28]	$33,557,000-$28,859,000	$4,698,000
Adjustment to dollars affected[29]	$(28,859,999)/9.5	$3,037,000
Total after adjustment[30]		**$7,735,000**

This estimate suggests that the net resource benefit for lighting end use measures was $25,822,000 ($33,557,000-$7,735,000) too high. The net resource benefit associated with the retention study for all end use measures across two program years (1994 & 1995) was $184,820,000. The impact as a percent of the total net resource benefit associated with the program for those two years is 14%.

This represents a worst-case scenario in terms of the dollars impacted, because there are more dollars associated with this study, there are more measures affected and the highest realization rate has been assumed for all measures.

Another estimate of the dollars impacted would involve adjusting each measure by how much the *ex post* is assumed to be "off" or mis-estimated / wrongly assigned. Again if the measures

[26] For future calculations we can use actual savings estimates.

[27] Figures are taken from E-tables for end use measures for each program year.

[28]. The dollars not affected takes the dollars claimed for that end use measure and subtracts the dollars associated with those measures whose EULs were too high. The result is the dollars claimed for that end use measure that appears to be correct.

[29]. The adjustment to dollars affected corrects the dollars claimed for those measures that have EULs that are too high. In this case, $28,859,000 worth of lighting measures were incorrect. Here we assume that they were 9.5 times too high. The correction is then $28,859,000/9.5.

[30] The total after adjustment is then the sum of the two previous rows. This new figure represents what should have been claimed for the lighting end use measures.

are assumed to have the same savings (in the absence of additional information), we can correct the net resource benefits as shown in Table 7.5.

Table 7.5. Adjustment to net Resource Benefit for 1994 Lighting Measures: Method 2

Description	Calculation	Result
Dollars not affected	$33,557,000-$28,859,000	$4,698,000
Adjustment to dollars affected		
2FO32/1B4T8-2L/1R4-D2	29.4%x(28,859/4.53)	$1,873,000
2FO32/1B4T8-2L/1R4-D1	22.9%x(28,859/4.25)	$1,555,000
2FO32/1B4T8-2L	46.3%x(28,859/1.89)	$7,069,000
Occupancy Sensors	1.5%x(28,859/9.5)	$45,000
Total after adjustment		**$15,240,000**

This estimate suggests that the net resource benefit for lighting end use measures was $15,240,000 too high. The impact as a percent of the total net resource benefit associated with the program for those two years is 10%.

7.3 Re-estimation of EULs – Re-running Measure Life Estimates

The analysis team requested the underlying data from a number of studies that were identified to have poor methodology scores. The results of our re-estimation of the EULs for these studies are provided in a table in Attachment D and Attachment E. For several of the studies, the data that were provided by the utilities were missing failure dates. The results in the Table in Attachment D demonstrate the range of estimates that can be derived based on variations in assumptions about the dates for failures. Because of the data issues, and the fact that detailed re-analysis of these results were outside the core scope of the project, these results were not used in assigning or revising EUL lifetimes. In Attachment E, however, we do recommend that adopted EULs be revised based on the analysis.

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7.4 Studies that may have dollars at risk

For a subset of studies that have estimated *ex post* values greater than the *ex ante* values, it is useful to examine the implications of whether the *ex post* values may be too high and the *ex ante* values may be a more conservative and appropriate estimate. This discussion assumes that the *ex ante* values are the correct estimates and considers the dollars as defined by the net resource benefit (RBn), that may be overstated in the filings due to the use of *ex post* values that are too high. We include a discussion below for studies for which we received additional data and for which measures had *ex post* was greater than the *ex ante* EUL values.

Table 7.6. Study ID 921 SDG&E (Program Years 1994 & 1995)

Measure	Number of Measures in Program	Realization Rate	Percent of total measures
CFL Bulbs	592,407	1.36	89%
Fixtures	72,629	1.0	11%
Total Measures	665,036		
Total dollars claimed (thousands)	$28,510		
Dollars for Bulbs – 89% of $28,510 (thousands)	$25,396	1.36	
Adjusted Dollars for Bulbs $ 25,396/1.36	$18,637	1.0	
Dollars for Fixtures	$3,136	1.0	
Total Dollars adjusted – Adjusted dollars for bulbs + dollars for fixtures	$21,773		

The net resource benefit may have been $6,737,000 too high ($28,510,000-$21,773,000) or 31% too high.

This calculation involves the following assumptions, which may be adjusted with more complete information:

1) The savings is assumed to be equal for each measure installed. Given savings estimates for the individual measures, further refinements can be made.
2) The net resource benefit used in the calculation involving the EUL where the Net resource benefit = EUL x program savings x TDF is assumed to equal the net resource benefit reported in the E tables. Further adjustments may need to be made if necessary.

Other studies where the ex post > ex ante for which we have data are provided in Table 7.7.

Table 7.7. Study ID 922 SDG&E (Program Years 1994 & 1995)

Measure	Number of Measures in Program	Realization Rate	Percent of total measures
CFL Bulbs	592,407	1.07	89%
Fixtures	72,629	1.0	11%
Total Measures	665,036		
Total dollars claimed (thousands)	$30,506		
Dollars for Bulbs – 89% of $30,506 (thousands)	$27,150	1.07	
Adjusted Dollars for Bulbs $ 27,150/1.07	$25,374	1.0	
Dollars for Fixtures – 11% of $30,506	$3,356	1.0	
Total Dollars adjusted – Adjusted dollars for bulbs + dollars for fixtures	$28,730		

The net resource benefit may be $1,776,000 too high ($30,506,000-$28,730,000) or 6.2% too high.

Table 7.8. Study ID 985 SDG&E (Program Years 1996 & 1997)

Measure	Number of Measures in Program	Realization Rate	Percent of total measures
CFL Bulbs	483,743	1.18	65%
Fixtures	260,324	1.0	35%
Total Measures	744,067		
Total dollars claimed (thousands)	$31,292		
Dollars for Bulbs – 65% of $31,292 (thousands)	$20,340	1.18	
Adjusted Dollars for Bulbs $ 20,340/1.18	$17,237	1.0	
Dollars for Fixtures – 35% of $31,292	$10,952	1.0	
Total Dollars adjusted – Adjusted dollars for bulbs + dollars for fixtures	$28,189		

The net resource benefit may be $3,103,000 too high ($31,292,000-$28,189,000) or 11% too high.

8 CONCLUSIONS AND IMPLICATIONS

The detailed review of retention and realization studies analyzed the approach, data, methods, and conclusions associated with 54 distinct reports representing 94 studies. The evaluation method and evaluation criteria are summarized in the report, but included:

- conformance with CPUC protocols,
- sampling approach, sample sizes and data collection procedures,
- modeling approach, estimation method, and consideration of alternative models, and
- results and implications.

Resource benefit, net (RBn) dollars were associated with studies where it was possible to assign the claims to specific programs and studies (they could be assigned for 50 of the 54 studies). The total dollars assigned were $2,217,908,000 (expressed in 1997 dollars). A total of 43% of the dollars were associated with programs and measures at SDG&E, 34% with SCE, 23% with PG&E, and 0.1% with SCG. Measures in the non-residential sector represented more than 90% of these dollars.

8.1 EUL Assessment from Low Scoring Reports

The SERA team examined the lowest scoring reports to assess whether or not the EULs should be adjusted. We selected a cutoff of reports that were assigned a "C-" or lower, selecting a total of 14 reports for analysis (26% of all the reports we reviewed). These studies represented 22.5% of the Resource Benefit, net dollars reviewed.[31] Within these studies, we focused on those reports that had EUL realization rates of over 1.0; five of the reports met this criterion (i.e., accepted *ex post* EULs that were greater than the *ex ante* EULs). Each of these reports is discussed in more detail below.

- ***SDG&E Study 924&960: 1994 & 1995 Commercial Energy Efficiency Incentives. Fourth Year Retention Evaluation***. This study had a number of measures with adopted *ex post* EULs that were extremely high. For example, four foot T8/2lamp fixtures had an accepted ex post of 90.6 years, compared to the *ex ante* of 20 years. Another T8 fixture had an adopted *ex post* value of 85.0 years. While the survival model may have provided these estimates, they are clearly beyond a reasonable level given changes that are likely to occur in technology. In addition, the building life may not even be this long. The SERA team understands that these values may have been rejected during the ORA review process. If this is not the case, we recommend that the *ex ante* values be accepted for the T8 and occupancy sensor measures in this study.
    - Total associated resource benefit, net for the study: $184,820,000 (8.9% of total RBn reviewed)
    - Recommendation: Reject *ex post* estimates, retain *ex ante* values.
    - Estimated potential shareholder earnings claim dollar impact: $0. SDG&E used *ex ante* figures in the shareholder earnings claim computations.

[31] Specifically, 15.4% ($319,992,000 in 12 studies) received C-, 1.4% ($28,510,000 in 1 study) received D+, and 5.7% ($118,490,000 in 1 study) received D-.

- ***SDG&E Study 985: 1996 & 1997 Residential Appliance Efficiency Incentives Program: Compact Fluorescent Lights Sixth Year Retention Evaluation***. This residential study had only two measures, CFLs and lighting fixtures. The CFLs adopted an *ex post* of 7.5 years, compared to an *ex ante* value of 6.4 years. The fixtures accepted the *ex ante* value of 17.2 years. Given that only 28% of the CFLs had failed during the sixth year, it does not appear unreasonable to accept the *ex post* value. In addition, five commercial studies had an average EUL of nine years, even higher than the residential (and we would expect higher usage for commercial lights).
    - Total associated resource benefit, net for the study: $31,292,000 (1.5% of total RBn reviewed)
    - Recommendation: Allow longer *ex post* values for CFLs (7.5 vs. 6.4 years); retain *ex ante* values for fixtures.
    - Estimated potential shareholder earnings claim dollar impact: +$403,212. This is an approximate figure computed as half the 2-year impact computed by SDG&E in response to a data request. SDG&E rounds EULs to the nearest full year in computing shareholder earnings claims. The computations extend the EUL from 6 to 8 years. We used an approximate based on half this value to represent the 1.1 year change from 6.4 to 7.5 years. SDG&E used *ex ante* EULs for CFLs in the claims computations.

- ***SDG&E Study 921: 1994 & 1995 Residential Appliance Efficiency Incentives: Compact Fluorescent Lights. Fourth Year Retention Evaluation***. This residential study had only two measure, CFLs and lighting fixtures. In this study, an *ex post* value of 10.2 years was adopted for the CFLs, compared to an *ex ante* value of 7.5 years. For fixtures, the *ex ante* value of 20.0 years was accepted. Given that only 27% of the CFLs had failed during the fourth year, it does not appear unreasonable to accept the *ex post* value. As mentioned above, five commercial studies had an average EUL of nine years, even higher than the residential (and we would expect higher usage for commercial lights).
    - Total associated resource benefit, net for the study: $28,510,000 (1.4% of total RBn reviewed)
    - Recommendation: Allow longer *ex post* values for CFLs (10.2 years vs. 7.5 years); retain *ex ante* values for fixtures.
    - Estimated potential shareholder earnings claim dollar impact: -$4,180.

- ***SDG&E Study 922: 1994 & 1995 Residential Appliance Efficiency Incentives Program: Compact Fluorescent Lights: Sixth year Retention Study***. This residential study included two measures, CFLs and lighting fixtures. The *ex post* adopted for CFLs was 8.0 years, compared to an ex ante value of 7.5 years. For fixtures, the *ex ante* value of 20.0 years was rejected and the EUL was *reduced* to 17.2 years. Once again, considering that few CFLs had failed at the time of the study, it does not appear unreasonable to accept the *ex post* value. In addition, five commercial studies had an average EUL of nine years, even higher than the residential (and we would expect higher usage for commercial lights).
    - Total associated resource benefit, net for the study: $30,506,000 (1.5% of total RBn reviewed)
    - Recommendation: Allow longer *ex post* values for CFLs (8.0 years vs. 7.5 years); support reduction of value for fixtures (17.2 years reduced from 20.0).
    - Estimated potential shareholder earnings claim dollar impact: $0. SDG&E used *ex ante* figures in the shareholder earnings claim computations.

- ***PG&E Study 315R2, 321R2, 329R2, 331R2: 6th Year Retention Study of Pacific Gas and Electric's 1994 and 1995 Energy Efficiency Incentives Programs, Agricultural Sector Measures***. This study included six measures, all but one of which accepted the *ex ante* value. The one measure that accepted the *ex post* value, heat curtains, rejected the EUL of 5.0 years and adopted an EUL of 15.0 years. There were 33 participant sites, 26 were in sample, and 94% of the square footage of curtains was still in place and operable after five years. So it appears reasonable to use 15 years.
    - Total associated resource benefit, net for the study: $19,835,000 (1.0% of total RBn reviewed)
    - Recommendation: Accept longer *ex post* value for heat curtains (15.0 vs. 5.0 years); accept *ex ante* values for all other measures analyzed.
    - Estimated potential shareholder earnings claim dollar impact: $0.

In addition, the SERA team examined data from another study, SCG 718. This small commercial new construction program had 13 measure categories, mostly cooking equipment in commercial kitchens. Five of the 13 measures had already had at least 50% of the measures removed or failed (and for a sixth measure – SHW – 46% of the measures had been removed or failed) by the fourth year of the Program, yet these measures maintained EULs 12 years because the sample size was too small to run a survival analysis. **We would recommend, therefore, that the methodology for the acceptance or rejection of the *ex ante* value include provisions for measures that have already met or surpassed the median failure rate.**[32]

An additional 13 studies received a score of "C" or "C+". These studies represented 5.4% of the Resource Benefit, net dollars reviewed.[33] Two of these 13 "second round" studies had EUL realization rates of over 1.0 (i.e., accepted *ex post* EULs that were greater than the *ex ante* EULs). Each of these reports is discussed in more detail below.

- ***SDG&E Study 927&963: 1994 & 1995 Industrial Energy Efficiency Incentives.*** This study had two measures with adopted *ex post* EULs that exceeded the *ex ante* values. One of these measures, exit signs, rejected an *ex ante* value of 20 years for an *ex post* value of 206.9 years, clearly well beyond any reasonable value. Another measure, T-8 electric ballasts, accepted an *ex post* value of 32.8 years, compared to an *ex ante* value of 16 years. This value is far higher than the four other industrial studies for ballasts, which accepted *ex post* values of 10 to 16 years.
    - Total associated resource benefit, net for the study: $21,261,000 (1.0% of total RBn reviewed)
    - Recommendation: Reject *ex post* estimates, retain *ex ante* values.
    - Estimated potential shareholder earnings claim dollar impact: $0. SDG&E used *ex ante* figures in the shareholder earnings claim computations.

- ***SDG&E Study 993 & 1017: 1996 & 1997 Commercial Energy Efficiency Incentives.*** This study accepted the ex ante for all but two measures: for 11-15watt CFLs the study rejected an *ex ante* EUL of two years for an ex post of 8.8 years, while for optical reflectors the study rejected an *ex ante* EUL of 20 years for *ex post* EUL of 154.3 years. The adjustment for CFLs, based on the other commercial lighting studies, appears acceptable, but the EUL of over 150 years for the optical reflectors is clearly unreasonable.

[32] The resource benefit, net dollars associated with this study were unavailable.

[33] Specifically, 5.0% ($103,027,000 in 13 studies) received C, 1.4% ($28,510,000 in 1 study) received D+, and 0.4% ($7,991,000 in 3 studies) received C+.

- Total associated resource benefit, net for the study: $139,190,000 (6% of total RBn reviewed)
- Recommendation: Reject *ex post* estimate of optical reflectors, retain *ex ante* value. Accept *ex post* value for 11-15 watt CFLs.
- Estimated potential shareholder earnings claim dollar impact: $0. SDG&E used *ex ante* figures in the shareholder earnings claim computations.

Based on the results of these analyses, we estimated that a total of $399,032 in *higher* claims to the utilities could be potentially justified.

9 ATTACHMENT A: INITIAL RETENTION STUDY LIST FROM CPUC

Program Year	Utility	Study ID	Description	Report Type	ORA Report Type	AEAP	Notes
1994	SCE	530	Nonresidential New Construction	Retention Study (3rd Earnings Claim)	RM	1999	
1994	SCE	529 A,B,C	Commercial/Industrial/Ag Energy Efficiency Incentives	Retention Study (3rd Earnings Claim)	RM/VR	1999	
1994	SCE	547B & 558B	Industrial Energy Efficiency Incentives	Retention Studies (4th Earnings Claim)		2003	for 2004 earnings claim
1994	SCE	547C & 558C	Agricultural Energy Efficiency Incentives	Retention Studies (4th Earnings Claim)		2003	for 2004 earnings claim
1995	SCE	547B & 558B	Industrial Energy Efficiency Incentives	Retention Studies (4th Earnings Claim)		2003	
1995	SCE	547C & 558C	Agricultural Energy Efficiency Incentives	Retention Studies (4th Earnings Claim)		2003	
1996	SCE	530	Nonresidential New Construction	Retention Study (3rd Earnings Claim)		2001	submitted and approved in 1999 AEAP
1996	SCE	555	Nonresidential DSM Bidding	Retention Study (3rd Earnings Claim)	VR	2001	
1996	SCE	553	Commercial Industrial Agricultural EEI	Retention Study (3rd Earnings Claim)	VR	2001	
1996	SCE	547B & 558B	Industrial Energy Efficiency Incentives	Retention Studies (4th Earnings Claim)		2003	for 2006 earnings claim
1996	SCE	547C & 558C	Agricultural Energy Efficiency Incentives	Retention Studies (4th Earnings Claim)		2003	for 2006 earnings claim
1997	SCE	555	Nonresidential DSM Bidding	Retention Study (3rd Earnings Claim)	VR	2001	
1997	SCE	553	Commercial Industrial Agricultural EEI	Retention Study (3rd Earnings Claim)	VR	2001	
1997	SCE	530	Nonresidential New Construction	Retention Study (3rd Earnings Claim)		2002	submitted and approved in 1999 AEAP
1997	SCE	547B & 558B	Industrial Energy Efficiency Incentives	Retention Studies (4th Earnings Claim)		2003	for 2007 earnings claim
1997	SCE	547C & 558C	Agricultural Energy Efficiency Incentives	Retention Studies (4th Earnings Claim)		2003	for 2007 earnings claim

Program Year	Utility	Study ID	Description	Report Type	ORA Report Type	AEAP	Notes
Paid in 1998	SCE	530	Nonresidential New Construction	Retention Study (3rd Earnings Claim)		2003	submitted and approved in 1999 AEAP
1994	PG&E	311R2, 328R2, 314R2, 325R2	Industrial Energy Efficiency Incentives	Retention Studies (4th Earnings Claim)	VR	2001	
1994	PG&E	315R2, 321R2, 329R1, 331R2	Agricultural Energy Efficiency Incentives	Retention Studies (4th Earnings Claim)	VR	2001	
1994	PG&E	384R2, 401bR2	Residential Appliance Efficiency Incentives	Retention Studies (4th Earnings Claim)	VR	2001	
1995	PG&E	399R2 a, b, c	Power Savings Partners	Retention Studies	VR	2000	
1996	PG&E	386R1	Residential New Construction	Retention Studies (3rd Earnings Claim)	VR	2001	
1996	PG&E	349R1, 351R1	Commercial Energy Efficiency Incentives	Retention Studies (3rd Earnings Claim)	VR	2001	
1996	PG&E	350R1, 334bR1, 353R1, 334aR1	Industrial Energy Efficiency Incentives	Retention Studies (3rd Earnings Claim)	VR	2001	
1996	PG&E	372R1	Residential Appliance Efficiency Incentives	Retention Studies (3rd Earnings Claim)	VR	2001	
1996	PG&E	396a, b, c, d, e, f, R1	Power Savings Partners	Retention Studies (3rd Earnings Claim)	VR	2001	
1996	PG&E	354R1, 385R1, 335a, b, c R1	Agricultural Energy Efficiency Incentives	Retention Studies (3rd Earnings Claim)	VR	2001	
1996	PG&E	373R1	Residential Appliance Efficiency Incentives	Retention Studies (3rd Earnings Claim)	VR	2001	
1996	PG&E	353R2, 334aR2, 350R2, 334bR2	Industrial Energy Efficiency Incentives	Retention Studies (4th Earnings Claim)		2003	
1996	PG&E	354R2, 385R2, 335aR2, 335bR2, 335cR2	Agricultural Energy Efficiency Incentives	Retention Studies (4th Earnings Claim)		2003	
1997	PG&E	398a, b R1, 398d, e R1	Power Savings Partners: Commercial Lighting, Industrial Process	Retention Studies (3rd earnings claim)		2002	
1997	PG&E	396a, b, c, d, e, f R1, 398f, g R1	Power Savings Partners: Residential Lighting, Gas Boilers	Retention Studies (3rd earnings claim)		2002	
1997	PG&E	354R1, 385R1, 335a, b, c R1	Agricultural Energy Efficiency Incentives	Retention Studies (3rd Earnings Claim)	VR	2001	
1997	PG&E	373R1	Residential Appliance Efficiency Incentives	Retention Studies (3rd Earnings Claim)	VR	2001	
1997	PG&E	353R2, 334aR2, 350R2, 334bR2	Industrial Energy Efficiency Incentives	Retention Studies (4th Earnings Claim)		2003	

Program Year	Utility	Study ID	Description	Report Type	ORA Report Type	AEAP	Notes
1997	PG&E	354R2, 385R2, 335aR2, 335bR2, 335cR2	Agricultural Energy Efficiency Incentives	Retention Studies (4th Earnings Claim)		2003	
2000	PG&E	425a, b, c	Power Savings Partners: Commercial Lighting, Traffic Lighting, HVAC	Retention Studies (3rd earnings claim)		2002	
2000	PG&E	426a, b, c	Power Savings Partners: Industrial Process, Lighting, Motors	Retention Studies (3rd earnings claim)		2002	
1995	SoCalGas	718	Nonresidential New Construction	Retention Studies	VR	2000	
1996	SoCalGas	720	Commercial Energy Efficiency Incentives	Retention Studies (3rd Earnings Claim)	VR	2001	
1994	SDG&E	930 & 966	Agricultural Energy Efficiency Incentives	Retention Studies (3rd Earnings Claim)	VR	2001	
1994	SDG&E	931 & 967	Agricultural Energy Efficiency Incentives	Retention Studies (4th Earnings Claim)	VR	2001	
1994	SDG&E	924 & 960	Commercial Energy Efficiency Incentives	Retention Studies (3rd Earnings Claim)		1999	
1994	SDG&E	927 & 963	Industrial Energy Efficiency Incentives	Retention Studies (3rd Earnings Claim)	VR	2001	
1994	SDG&E	928 & 964	Industrial Energy Efficiency Incentives	Retention Studies (4th Earnings Claim)	VR	2001	
1994	SDG&E	936 & 972	Nonresidential New Construction	Retention Studies (3rd Earnings Claim)		1999	
1994	SDG&E	921	Residential Appliance Efficiency Incentives - CFL	Retention Studies (3rd Earnings Claim)		1999	
1994	SDG&E	922	Residential Appliance Efficiency Incentives - CFL	Retention Studies (4th Earnings Claim)	VR	2001	
1994	SDG&E	915	Residential Appliance Efficiency Incentives - Ref	Retention Studies (3rd Earnings Claim)		1999	
1994	SDG&E	933	Residential New Construction	Retention Studies (3rd Earnings Claim)		1999	
1995	SDG&E	930 & 966	Agricultural Energy Efficiency Incentives	Retention Studies (3rd Earnings Claim)	VR	2001	
1995	SDG&E	931 & 967	Agricultural Energy Efficiency Incentives	Retention Studies (4th Earnings Claim)	VR	2003	
1995	SDG&E	924 & 960	Commercial Energy Efficiency Incentives	Retention Studies (3rd Earnings Claim)	VR	1999	
1995	SDG&E	927 & 963	Industrial Energy Efficiency Incentives	Retention Studies (3rd Earnings Claim)	VR	2001	
1995	SDG&E	928 & 964	Industrial Energy Efficiency Incentives	Retention Studies (4th Earnings Claim)	VR	2001	
1995	SDG&E	921	RAEI - CFL	Retention Studies (3rd Earnings Claim)		1999	
1995	SDG&E	922	RAEI - CFL	Retention Studies (4th Earnings Claim)		2003	
1995	SDG&E	915	RAEI - Refrigertation	Retention Studies (3rd Earnings Claim)		1999	
1995	SDG&E	933	RNC	Retention Studies (3rd Earnings Claim)		1999	
1995	SDG&E	936 & 972	NRNC	Retention Studies (3rd Earnings Claim)	VR	1999	
1996	SDG&E	999 & 1023	Agricultural Energy Efficiency Incentives	Retention Studies (3rd Earnings Claim)	VR	2001	
1996	SDG&E	1000 & 1024	Agricultural Energy Efficiency Incentives	Retention Studies (4th Earnings Claim)		2003	
1996	SDG&E	993 &1017	Commercial Energy Efficiency Incentives	Retention Studies (3rd Earnings Claim)	VR	2001	
1996	SDG&E	996 & 1020	Industrial Energy Efficiency Incentives	Retention Studies (3rd Earnings Claim)	VR	2001	
1996	SDG&E	1005	Nonresidential New Construction	Retention Studies (3rd Earnings Claim)	VR	2001	

Program Year	Utility	Study ID	Description	Report Type	ORA Report Type	AEAP	Notes
1996	SDG&E	981	Residential Appliance Efficiency Incentives - Ref	Retention Studies (3rd Earnings Claim)	VR	2001	
1996	SDG&E	984	Residential Appliance Efficiency Incentives - CFL	Retention Studies (3rd Earnings Claim)	VR	2001	
1996	SDG&E	922	Residential Appliance Efficiency Incentives	Retention Studies (4th Earnings Claim)	VR	2001	
1996	SDG&E	1002	Residential New Construction	Retention Studies (3rd Earnings Claim)	VR	2001	
1996	SDG&E	990	Resid'l Weatherization Retrofit Incentives	Retention Studies (3rd Earnings Claim)	VR	2001	
1997	SDG&E	999 & 1023	Agricultural Energy Efficiency Incentives	Retention Studies (3rd Earnings Claim)	VR	2001	
1997	SDG&E	1000 & 1024	Agricultural Energy Efficiency Incentives	Retention Studies (4th Earnings Claim)		2003	
1997	SDG&E	993 &1017	Commercial Energy Efficiency Incentives	Retention Studies (3rd Earnings Claim)	VR	2001	
1997	SDG&E	1017	Fuel Substitution Program	Retention Studies (3rd earnings claim)		2002	
1997	SDG&E	996 & 1020	Industrial Energy Efficiency Incentives	Retention Studies (3rd Earnings Claim)	VR	2001	
1997	SDG&E	997 & 1021	Industrial Energy Efficiency Incentives	Retention Studies (4th Earnings Claim)	VR	2003	
1997	SDG&E	1005	Nonresidential New Construction	Retention Studies (3rd Earnings Claim)	VR	2001	
1997	SDG&E	981	Residential Appliance Efficiency Incentives - Ref	Retention Studies (3rd Earnings Claim)	VR	2001	
1997	SDG&E	984	Residential Appliance Efficiency Incentives - CFL	Retention Studies (3rd Earnings Claim)	VR	2001	
1997	SDG&E	985	Residential Appliance Efficiency Incentives - CFL	Retention Studies (4th Earnings Claim)		2003	
1997	SDG&E	1002	Residential New Construction	Retention Studies (3rd Earnings Claim)	VR	2001	
1997	SDG&E	990	Resid'l Weatherization Retrofit Incentives	Retention Studies (3rd Earnings Claim)	VR	2001	

10 ATTACHMENT B: TECHNICAL EVALUATION SCORESHEET FOR RETENTION AND REALIZATION RATE STUDIES

(Excel Sheet under separate cover)

11 ATTACHMENT C: ON-SITE EVALUATION SCORESHEET

(Excel Sheet under separate cover)

12 ATTACHMENT D: RE-ANALYSIS OF EUL ESTIMATES FOR SELECTED SDG&E STUDIES

The analysis team requested the underlying data from a number of studies that were identified to have poor methodology scores. The results and comparisons to *ex post* and *ex ante* estimates for the studies is included in Table D1. The results of our re-estimation of the EULs for these studies are provided in Table D2. For several of the studies, the data that were provided by the utilities were missing failure dates. Table D2 demonstrates the range of estimates that can be derived based on variations in assumptions about the dates for failures. Because of the data issues, and the fact that detailed re-analysis of these results were outside the core scope of the project, these results were not used in assigning or revising EUL lifetimes.

The following are the *ex ante* and *ex post* figures for various studies, and which values were accepted / recommended by the original studies.

Table D1. *Ex ante* and *ex post* EUL values for selected studies and measures

Study	Measure	*Ex ante* (years)	*Ex post* (years)	Results
985	Fixture	17.2 years (accepted)	20.0	Results from Table D2 vary dramatically depending on assumptions about failure dates
985	Bulbs	6.4	7.5 (accepted)	Most models in Table D2 support failure dates longer than *ex ante* values for this measure, with variations by assumptions.
921	Fixture	20.0 (accepted)		This estimate is supported by exponential and Weibull estimates in Table D2 (with uniform failure assumption) and exponential model (assuming failures one day before study). Other estimates vary from 3 to 62 years.
921	Bulbs	7.5	10.2 (accepted)	Estimates longer than 7.5 years are supported by three of the models in Table D2(Exponential for both assumptions about failure dates, and Weibull for uniform failure date assumption). Other models show estimates ranging from 4 years to 15 years.
921	Fixture	20.0	17.2 (accepted)	Results in Table D2 show that 2 of the models support 20 year EULs (and another supports 21 years); several that assume failures all happened the day before the survey estimated very short lifetimes (5 years).

Table D.2: Results of Re-estimation of EULs for Selected Studies and Measures – Results based on variations in assumptions for missing failure dates.

Study ID	Measure	Assumption about Failure Date for Missing Values	Nth year Retention Study	Program Years	Distribution	EUL estimate	Lower Limit 80% CI	Upper Limit 80% CI	Log Likelihood	Notes
985	Fixture	Uniform failure over n or n-1 years	6	1996/1997	Lognormal	57	52	62	-6536	
		Uniform failure over n or n-1 years	6	1996/1997	Exponential	25	24	26	-6510	
		Uniform failure over n or n-1 years	6	1996/1997	Weibull	24	23	26	-6509	
		Uniform failure over n or n-1 years	6	1996/1997	Gamma	20	19	21	-6510	
		1 day before survey	6	1996/1997	Lognormal	6	6	6	-1932	
		1 day before survey	6	1996/1997	Exponential	26	27	28	-5022	
		1 day before survey	6	1996/1997	Weibull	6	6	6	-2187	
		1 day before survey	6	1996/1997	Gamma					Did not Converge
985	Bulbs	Uniform failure over n or n-1 years	6	1996/1997	Lognormal	15	14	15	-23313	
		Uniform failure over n or n-1 years	6	1996/1997	Exponential	11	11	11	-23115	
		Uniform failure over n or n-1 years	6	1996/1997	Weibull	10	10	10	-23105	
		Uniform failure over n or n-1 years	6	1996/1997	Gamma	9	9	9	-23110	Did not Converge
		1 day before survey	6	1996/1997	Lognormal	6	6	6	-2806	
		1 day before survey	6	1996/1997	Exponential	12	12	12	-16756	
		1 day before survey	6	1996/1997	Weibull	6	6	6	-2770	
		1 day before survey	6	1996/1997	Gamma	2	6	18	-2429	Did not Converge
984	Fixture	Uniform failure over n or n-1 years	4	1996/1997	Lognormal	33	36	40	-4400	
		Uniform failure over n or n-1 years	4	1996/1997	Exponential	15	16	16	-4382	

Study ID	Measure	Assumption about Failure Date for Missing Values	Nth year Retention Study	Program Years	Distribution	EUL estimate	Lower Limit 80% CI	Upper Limit 80% CI	Log Likelihood	Notes
		Uniform failure over n or n-1 years	4	1996/1997	Weibull	15	16	18	-4382	
		Uniform failure over n or n-1 years	4	1996/1997	Gamma	12	13	14	-4382	Did not Converge
		1 day before survey	4	1996/1997	Lognormal	4	5	5	-1692	
		1 day before survey	4	1996/1997	Exponential	16	17	18	-3396	
		1 day before survey	4	1996/1997	Weibull	4	4	4	-1555	
		1 day before survey	4	1996/1997	Gamma	0	4	14038	-1512	Did not Converge
984	Bulbs	Uniform failure over n or n-1 years	4	1996/1997	Lognormal	9	9	8	-13578	
		Uniform failure over n or n-1 years	4	1996/1997	Exponential	7	7	7	-13444	
		Uniform failure over n or n-1 years	4	1996/1997	Weibull	6	6	7	-13440	Did not Converge
		Uniform failure over n or n-1 years	4	1996/1997	Gamma	6	6	6	-13443	
		1 day before survey	4	1996/1997	Lognormal	4	4	4	-3762	
		1 day before survey	4	1996/1997	Exponential	8	8	8	-9794	
		1 day before survey	4	1996/1997	Weibull	4	4	4	-3809	
		1 day before survey	4	1996/1997	Gamma	0	4	5012	-3636	Did not Converge
921	Fixture	Uniform failure over n or n-1 years	4	1994/1995	Lognormal	32	44	62	-528	
		Uniform failure over n or n-1 years	4	1994/1995	Exponential	17	19	22	-529	
		Uniform failure over n or n-1 years	4	1994/1995	Weibull	14	18	23	-529	
		Uniform failure over n or n-1 years	4	1994/1995	Gamma	29	60	123	-528	Did not Converge
		1 day before survey	4	1994/1995	Lognormal	3	3	3	-317	
		1 day before survey	4	1994/1995	Exponential	18	20	23	-416	
		1 day before survey	4	1994/1995	Weibull	3	3	3	-306	
		1 day before survey	4	1994/1995	Gamma	3	3	3	-305	Did not Converge

Study ID	Measure	Assumption about Failure Date for Missing Values	Nth year Retention Study	Program Years	Distribution	EUL estimate	Lower Limit 80% CI	Upper Limit 80% CI	Log Likelihood	Notes
921	Bulbs	Uniform failure over n or n-1 years	4	1994/1995	Lognormal	13	14	15	-2855	
		Uniform failure over n or n-1 years	4	1994/1995	Exponential	9	9	10	-2824	
		Uniform failure over n or n-1 years	4	1994/1995	Weibull	8	8	9	-2819	
		Uniform failure over n or n-1 years	4	1994/1995	Gamma	0	7	3708	-2817	Did not Converge
		1 day before survey	4	1994/1995	Lognormal	4	4	4	-647	
		1 day before survey	4	1994/1995	Exponential	10	10	11	-2103	
		1 day before survey	4	1994/1995	Weibull	4	4	4	-507	
		1 day before survey	4	1994/1995	Gamma	0	4	180000000	-430	Did not Converge
922	Fixture	Uniform failure over n or n-1 years	6	1994/1995	Lognormal	36	40	44	-4346	
		Uniform failure over n or n-1 years	6	1994/1995	Exponential	19	20	21	-4240	
		Uniform failure over n or n-1 years	6	1994/1995	Weibull	18	20	21	-4240	
		Uniform failure over n or n-1 years	6	1994/1995	Gamma	16	17	18	-4241	Did not Converge
		1 day before survey	6	1994/1995	Lognormal	5	5	5	-4075	
		1 day before survey	6	1994/1995	Exponential	21	22	23	-3200	
		1 day before survey	6	1994/1995	Weibull	5	5	5	-3958	
		1 day before survey	6	1994/1995	Gamma	5	5	5	-3934	Did not Converge

13 ATTACHMENT E: RE-ANALYSIS OF EUL ESTIMATES FOR SELECTED SCG STUDY

The SERA team conducted an analysis of the Southern California Gas 1995 Commercial New Construction Program Fourth Year Retention Study.[34] The primary goals of the analysis were to:

- Verify the assumptions used in cleaning/summarizing data for the EUL estimations
- Reestimate the EULs using alternative assumptions and distributions for the survival analysis

13.1 Methodology

SERA was provided with the Retention Survey Database (RSD), an Access database that contained the onsite survey results. The relevant tables were imported in SAS™, and frequencies and cross-tabs were reviewed. A number of data recoding/transformation steps were also conducted and reviewed.

A number of EULs were then estimated using the LIFEREG procedure in SAS™. The 80% confidence intervals were calculated, and different distributions were compared for goodness of fit.

13.2 Findings

SERA was able to replicate and confirm the total number of total measures installed, the number of measures installed in the retention survey sample, and the number of removals or failures that were identified. As demonstrated in Table E.1, 290 of the 790 measures (37%) in the retention sample had been removed or failed. For five of the measures – ovens, fryers, steamers, kettles, and other cooking equipment – at least 50% of the installed measures had been removed or failed at the time of the on-site survey (within 4.4 to 4.8 years after the measures were installed).[35]

As shown in Table E.2, we also summarized the number of removals or failures that also had valid dates associated with their removal or failure. If failed businesses are included, only 40% of the removed or failed measures had associated removal/failure dates. Even if failed businesses are excluded, only 48% of the removed or failed measures had associated dates.

[34] Robert Mowris & Associates, "Southern California Gas Company 1995 Commercial New Construction Program Fourth Year Retention Study," Study ID Number 718, February 2000.

[35] SERA calculated the number of years to removal or failure by first calculating the number of days from installation to removal or failure, dividing by 365, and then rounding to the first decimal place. It appeared that the report may have used the integer value – truncating the decimal place – in calculating years until failure.

Table E.1. Removals or Failures from Retention Sample

Measure	Actual Retention Sample Size	Actual Removals or Failures	% of Sample Removed or Failed	Maximum Life for Removals or Failures (Years)*
Oven	183	93	51%	4.8
Fryer	117	58	50%	4.4
Range	107	28	26%	4.4
Griddle	68	23	34%	4.6
Broiler	69	15	22%	4.8
HVAC	110	7	6%	1.6
Steamer	37	20	54%	4.8
Hot Food Table	20	3	15%	4.6
Kettle	26	17	65%	4.8
Braising Pan	1	0	0%	na
Other Cooking	20	13	65%	4.4
SHW	26	12	46%	4.8
Boiler	6	1	17%	0.5
Total	**790**	**290**	**37%**	**4.8**

*Note: The greatest number of years until failure/removal (based on only those sampled observations that failed or were removed)

Table E.2. Removals or Failures Including and Excluding Failed Businesses

	Including Failed Businesses			Excluding Failed Businesses		
Measure	Actual Removals or Failures	Removals or Failures with Valid Date	% of Removals or failures with Valid date	Revised Removals or Failures	Removals or Failures with Valid Date	% of Removals or failures with Valid date
Oven	93	36	39%	56	24	43%
Fryer	58	14	24%	43	12	28%
Range	28	13	46%	17	11	65%
Griddle	23	10	43%	12	7	58%
Broiler	15	6	40%	10	4	40%
HVAC	7	2	29%	4	2	50%
Steamer	20	11	55%	11	7	64%
Hot Food Table	3	3	100%	3	3	100%
Kettle	17	9	53%	13	9	69%
Braising Pan	0	0	Na	0	0	Na
Other Cooking	13	6	46%	12	6	50%
SHW	12	5	42%	9	5	56%
Boiler	1	1	100%	1	1	100%
Total	**290**	**116**	**40%**	**191**	**91**	**48%**

13.3 Survival Analysis

After verifying that the frequencies and cross-tabs from the RSD were correctly reported, we estimated parametric regression models (survival analysis) to re-estimate the EULs.[36] Due to small sample sizes and the high percentage of missing failure dates (right censoring), models were limited to the two equipment types in the report, ovens and fryers.

As shown in Table E.3, a number of alternative distributions – Weibull, exponential, and log-normal – were explored.[37] Depending on the model selected the EUL can vary substantially. For example, the median expected life for ovens, if business failures are included, can range from 5.6 (Weibull) to 9.8 (exponential) years.

Table E.3. Results from Survival Analysis

		Including Business Failures			Excluding Business Failures		
Equipment	**Distribution**	**LB 80% CI**	**Mean EUL**	**UP 80% CI**	**LB 80% CI**	**Mean EUL**	**UP 80% CI**
Oven	Weibull	5.1	5.6	6.1	5.9	6.9	8.2
	Exponential	7.9	9.8	12.1	10.3	13.4	17.3
	Log-normal	5.8	6.6	7.6	7.1	9.1	11.5
Fryers	Weibull	4.9	5.6	6.3	5.0	5.6	6.2
	Exponential	10.3	14.5	20.4	11.5	16.6	24.0
	Log-normal	5.4	6.3	7.5	5.4	6.3	7.5

Using the likelihood ratio test, however, we can select the distribution with the best fit. Taking the difference between the log-likelihood of two nested models and multiplying by 2 yields a likelihood ratio chi-square statistic. As shown in Table E.5, the exponential distribution differs significantly from the Weibull and log-normal distributions, plus has the highest log-likelihood; this model, therefore, should be rejected. The difference between the Weibull and log-normal are less conclusive, however: for ovens, the model including business failures is significantly different at the .01 level, but the model excluding failed businesses is only significant at the .1 level; for fryers there is no significant difference between the two models. We selected to accept the Weibull distribution, however, because it has a higher log-likelihood and is a more versatile distribution.

Table E.4. Log-Likelihoods from Different Models

Equipment	Distribution	Log-Likelihood (Including Business Failures)	Log-Likelihood (Excluding Business Failures)
Oven	Weibull	-72.8	-63.0
	Exponential	-90.3	-70.2
	Log-normal	-77.0	-64.5
	Generalized Gamma	NA	NA
Fryers	Weibull	-29.2	-24.4
	Exponential	-39.6	-35.0
	Log-normal	-29.5	-24.9
	Generalized Gamma	NA	NA

[36] Our analysis was conducted in SAS. As a preliminary analysis we used PROC LIFETEST to estimate survival curves. The regression models were run using PROC LIFEREG. The SAS output is presented in Appendix A

[37] Each of these distributions has different implications for the hazard function. The log-normal distribution assumes that the hazard function increases to a peak and then declines, the exponential distribution assumes a constant hazard function (unchanging), while the Weibull assumes the function can vary (increasing or decreasing with time). We also tested the generalized Gamma, which is the most versatile of all the models, but being the most computationally difficult the model failed to reach convergence. In addition to being common distributions, these distributions were also considered because they allow for goodness-of-fit tests with the likelihood ratio statistics (the Weibull, exponential, and log-normal are all nested within the generalized gamma model).

Table E.5. Likelihood Ratio Chi-Square Statistics

Equipment/Test	Including Business Failures	Excluding Business Failures
Ovens		
Weibull vs. Exponential	35.0**	14.4**
Weibull vs. Log-normal	8.4**	3.0*
Exponential vs. Log-normal	26.6**	11.4**
Fryers		
Weibull vs. Exponential	20.8**	21.2**
Weibull vs. Log-normal	0.6	1.0
Exponential vs. Log-normal	20.2**	20.2**
Table Notes: *Statistical difference (p<.1), **Statistical difference (p< .01)		

Comparing the modeled EULs with the ex ante reveals that the values should be rejected in favor of the EULs determined from the survival analysis. In other words, the EUL of 12 years should be rejected for both ovens and fryers; using the models that excludes business failures (as was done in the report), the new EULs would be 6.9 for ovens and 5.6 for fryers.

Table E.6. Comparison of Ex ante and Model EULs

		Including Business Failures				Excluding Business Failures			
Measure	Ex ante	80% LB	Median EUL	80% UB	Ex post	80% LB	Median EUL	80% UB	Ex post
Ovens	12	5.1	5.6	6.1	5.6	5.9	6.9	8.2	6.9
Fryers	12	4.9	5.6	6.3	5.6	5.0	5.6	6.2	5.6

13.4 Conclusions

The retention study calculated the survival functions for two measures, ovens and fryers, and determined that the ex ante EUL estimate of 12 years should be rejected as the ex post value and replaced by EULs of 6.9 years for ovens and 5.6 years for fryers.. The other measures had insufficient sample sizes to run survival functions, and thus maintained the EUL ex ante values.

However, as defined in the protocols the effective useful life is defined as the median number of years that the measure installed under the program is still in place and operable. Given that five of the measures had already had at least 50% of the measures removed or failed (and for a sixth measure – SHW – 46% of the measures had been removed or failed), excepting the ex ante values of 12 years seems unfounded.[38] As shown in Table E.1, the maximum number of years between installation and removal or failure for these measures ranged between 4.4 years and 4.8 years. These values would be more indicative of the median number of years to failure, as they are the point at which at least 50% of the measures had failed. We would recommend, therefore, that the methodology for the acceptance or rejection of the ex ante value include provisions for measures that have already met or surpassed the median failure rate.

[38] This assumes, of course, that the sample is representative of the population, but this assumption must also hold true for the survival analysis. In addition, we include business failures in this estimate, as there is no way to track if the equipment remains in the SCG service territory.

14 ATTACHMENT F: COMPUTATION OF ESTIMATED CLAIMS DOLLARS AFFECTED

Four studies met our critieria for computing dollars at risk. They:

- had ex post numbers proposed that were longer than ex ante,
- had resource benefit, net dollars that could be associated with the measures, and
- were derived from studies that had weak methodologies.

The computation of dollars at risk that appear in the Executive Summary and Chapter 8 are shown in the tables below. The methodology used derives from the methodology and examples presented in Section 7.2 of this report; however, we were able to find kilowatt-hours for most of the measures, so we can use values based on energy use and savings, rather than number of measures for most of the computed at risk dollars.

Table 14.1. Computation of Dollars at Risk

Uses methodology from Section 7.2 of report -- with kWh and kW where available

SDG&E 927&963

Measure	Quantity	kWh/Year	Total kWh	% kWh	Relative RBn (kWh)	kW/Year	Total kW	% kW	Relative RBn (kW)	Ex Ante	Ex Post	Real Rate	Adj RBn (kWh)	Adj Rbn (kW)	Total Adj RBn	Total Delta
PY95 T-8 El Ballasts	8,203	199.2	1,634,038	77%	$973,897	25.9	212,458	78%	$109,782	16	32.8	2.05	$475,072	$53,552	$528,624	**$555,055**
PY95 Exit Signs	1,376	351.3	483,389	23%	$288,103	42.5	58,480	22%	$30,218	20	206.9	10.35	$27,849	$2,921	$30,771	**$287,550**
PY95 Total Lighting	9,579	na	2,117,426	100%	$1,262,000		270,938	100%	$140,000				$502,921	$56,473	$559,394	**$842,606**

SDG&E 993&1017

Measure	Quantity	kWh/year	Total kWh	% kWh	Relative RBn (kWh)	kW/Year	Total kW	% kW	Relative RBn (kW)	Ex Ante	Ex Post	Real Rate	Adj RBn (kWh)	Adj Rbn (kW)
PY97 Traffic signals	18,219									20	20	1		
PY97 Exit signs	13,811	351.3				42.5				20	20	1		
PY97 Traffic Sig (12' arrow)	5,043									20	20	1		
PY97 Opt Refl (4ft/2dlamp)	10,590									16	154.3	9.6		
PY97 T-8 El Ballasts	35,888	199.2				25.9				16	16	1		
PY97 Opt Refl (4ft/1dlamp)	11,803									16	16	1		
PY97 4FO32/1B4T8-4L	3,056									20	20	1		
Total Lighting Measures	98,410	na	-	0%			-	0%					$0	$0

SDG&E Study 924/960 - CEEI

Measure	Quantity	kWh/unit	Total kWh	% kWh	Relative RBn (kWh)	kW/unit	Total kW	% kW	Relative RBn (kW)	Ex Ante	Ex Post	Real Rate	Adj RBn (kWh)	Adj Rbn (kW)	Total Adj RBn	Total Delta
PY94 T8 (2FO32/1B4T8-2L/1R4-D2	39,170	123	4,817,910	25%	$6,390,826	26	1,018,420	24%	$1,251,463	20	90.6	4.53	$1,410,778	$276,261	$1,687,040	**$5,955,250**
PY94 T8 (2FO32/1B4T8-2L/1R4-D1	30,504	123	3,751,992	19%	$4,976,915	26	793,104	18%	$974,589	20	85	4.25	$1,171,039	$229,315	$1,400,354	**$4,551,150**
PY94 T8 (2FO32/1B4T8-2L	61,624	123	7,579,752	39%	$10,054,335	26	1,602,224	37%	$1,968,858	20	37.9	1.89	$5,319,754	$1,041,724	$6,361,478	**$5,661,715**
Occupancy sensors	1,967	321.9	633,118	3%	$839,814	164	322,588	8%	$396,405	8	75.8	9.47	$88,682	$41,859	$130,541	**$1,105,679**
PY94 T8 (4FO32/1B4T8-2L	17,300	123	2,127,900	11%	$2,822,601	26	449,800	10%	$552,727	20	20	1	$2,822,601	$552,727	$3,375,328	**$0**
1CF13H	4,318	123	531,114	3%	$704,508	26	112,268	3%	$137,958							
Total	154,883		19,441,786				4,298,404									
PY94 Total lighting in dollars					$25,789,000				$5,282,000							$17,273,794

NOTES: kWh and kW for T8s derived as average of 29 values in CA DEER Studies for 34 watt T8s in commercial applications; data on distribution by sector, etc. not available from study
Values ofr kWh and kW for occupancy sensors derived as average of 2 values included in the CA DEER data on line.

SDG&E 993&1017

Measure	Quantity	kWh/year	Total kWh	% Measures	Relative RBn (kWh)	kW/Year	Total kW	% kW	Relative RBn (kW)	Ex Ante	Ex Post	Real Rate	Adj RBn (kWh)	Adj Rbn (kW)	Total Adj RBn	Total Delta
PY97 Traffic signals	18,219			19%	$2,609,273				$952,512	20	20	1	$2,609,273	$952,512	$3,561,786	**$0**
PY97 Exit signs	13,811	351.3		14%	$1,977,972	42.5			$722,057	20	20	1	$1,977,972	$722,057	$2,700,029	**$0**
PY97 Traffic Sig (12' arrow)	5,043			5%	$722,244				$263,654	20	20	1	$722,244	$263,654	$985,899	**$0**
PY97 Opt Refl (4ft/2dlamp)	10,590			11%	$1,516,670				$553,659	16	154.3	9.6	$157,270	$57,411	$214,681	**$1,855,647**
PY97 T-8 El Ballasts	35,888	199.2		36%	$5,139,777	25.9			$1,876,270	16	16	1	$5,139,777	$1,876,270	$7,016,047	**$0**
PY97 Opt Refl (4ft/1dlamp)	11,803			12%	$1,690,392				$617,076	16	16	1	$1,690,392	$617,076	$2,307,468	**$0**
PY97 4FO32/1B4T8-4L	3,056			3%	$437,672				$159,772	20	20	1	$437,672	$159,772	$597,443	**$0**
Total Lighting Measures	98,410	na	-	100%	$14,094,000		-	0%	$5,145,000				$12,734,600	$4,648,752	$17,383,353	**$1,855,647**